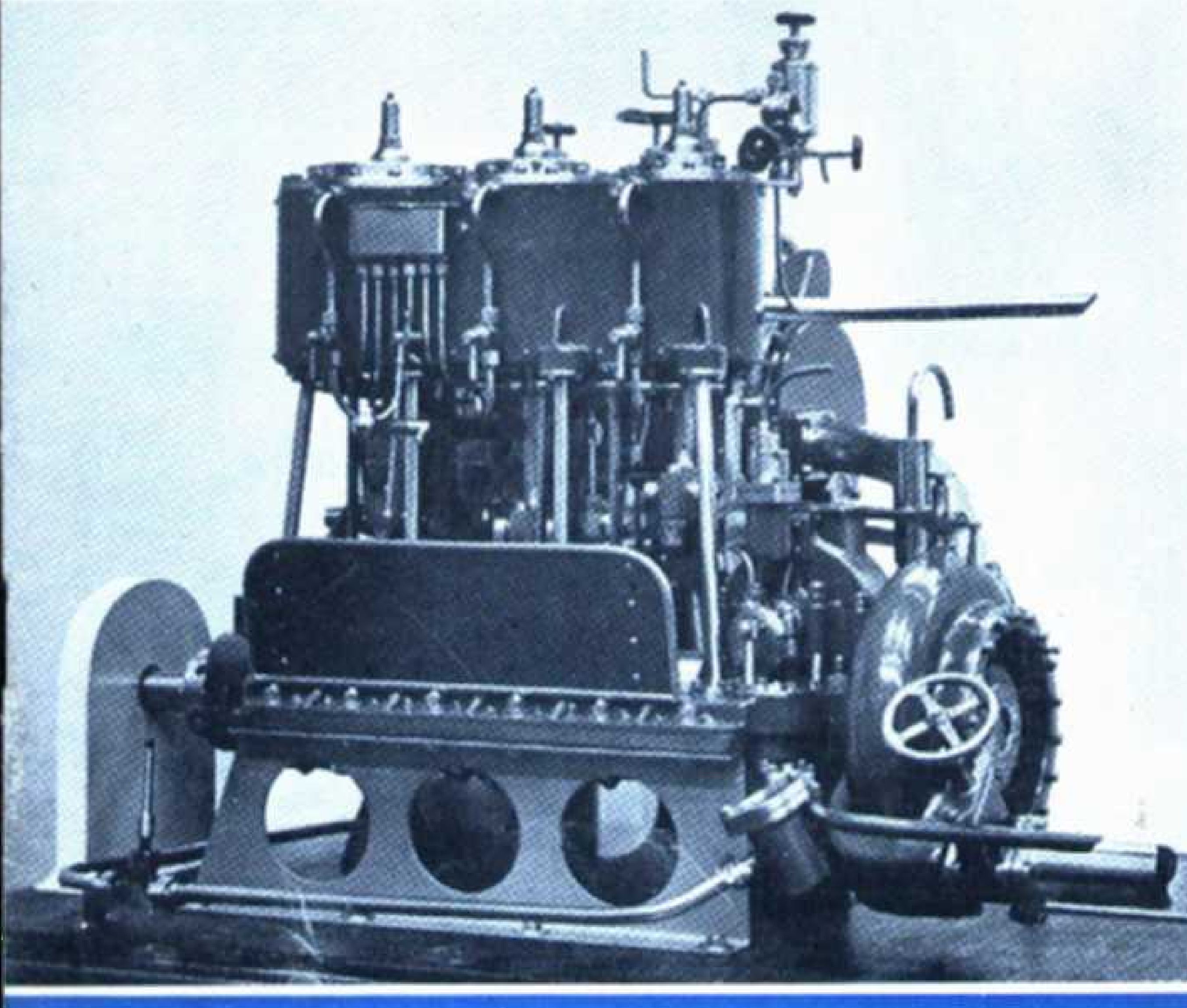
THE

MODEL ENGINEER



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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

Our opinion of the attractiveness of the marine steam engine as a prototype for modelling has been endorsed by several readers, who have asked for more information on authentic models of this type. As promised, we are publishing in this issue an article by Mr. A. W. G. Tucker on his model of a Savery launch engine, which won the Championship Cup in the General Models section of the 1952 "M.E." Exhibition. This particular type of engine, although unique in many important respects, still embodies sound marine engine practice, and represents one of the most efficient developments in reciprocating steam engines for light passenger craft. An unusual feature of the design was the incorporation of a centrifugal circulating pump, for the cooling of the surface condenser, on the forward end of the main shaft; also, the use of worm reduction gear for driving the air pump and other auxiliaries. Mr. Tucker has produced many interesting models of various types in the past, some of which have won awards at previous "M.E." Exhibitions; but none have more truly merited honourable distinction than this example.

SMOKE RINGS

We Reciprocate

● WE RECEIVED many Christmas cards from friends and well-wishers in nearly every country in the world where the "M.E." regularly circulates; the messages were cordial greetings and good wishes which we most heartily reciprocate. Several of the overseas senders recalled some occasion or occasions on which they had made our personal acquaintance, either in our offices or at the "M.E." Exhibition; others returned thanks for the pleasure which the "M.E." had given, sometimes in a very remote location.

A South African reader wrote: "To thank you for very many happy and instructive hours over the past thirty-five years." Most of us here now were very young when that kind gentleman began to read THE MODEL ENGINEER! We are very grateful to him for thinking of us, and to all the others as well. This annual tide of good will acts as a spur to us and puts us in good heart to renew our efforts at the beginning of a new year.

Monsieur G. M. Suzor

● MEMBERS OF the model power boat fraternity will be very sorry to learn that Monsieur G. M. Suzor, of Paris, has been injured as a result of a collision between his motorcycle and a car. He sustained a broken leg and facial injuries, but we have reason to believe that he is making a satisfactory recovery, and his many friends will, we are sure, join us in hoping that this will be speedy. Gems Suzor has played a very important part in the development of model speed boats from their pioneer days, and has many outstanding records to his credit. He has taken part in many events in this country, and has not always had luck on his side; many of his superb boats and engines have finished as complete wrecks, but his unfailing cheerfulness and sportsmanship has endeared him even to his bitterest rivals in this and other countries where the hectic but friendly sport of model power boat racing is practised.

Mr. A. D. Pole

● WE WERE extremely sorry to learn of the passing of Mr. Arthur D. Pole, of the Harrow and Wembley Society of Model Engineers. He had been ailing for some time, and died on December 17th last. We had known him for many years, not only as a charming personality, but as an ardent locomotive enthusiast. He was, in fact, one of the pioneers of the present enthusiasm for large-scale locomotives; about 40 years ago, he built his 5-in. gauge G.C.R. 4-6-2 tank engine, which is still in excellent working order; then followed a 4-4-2 tank engine based on the earlier types for the London Tilbury and Southend Railway. Both these engines were well known over many miles round Harrow. A third was completed about three years ago, and is a 5-in. gauge replica of the old London & North Western Railway's 8 ft. 6 in. singlewheeler *Cornwall.*

Mr. Pole was one of the founders of the Harrow Society of Model Engineers, and for many years its secretary. We often wondered at his vitality, for in addition to looking after the affairs of his own club, he was very often to be found taking part, with gusto, in the activities of neighbouring clubs, usually on the locomotive track. The members of his own club, as well as many friends outside it, will miss his cheery presence for many years to come.

Change of Name

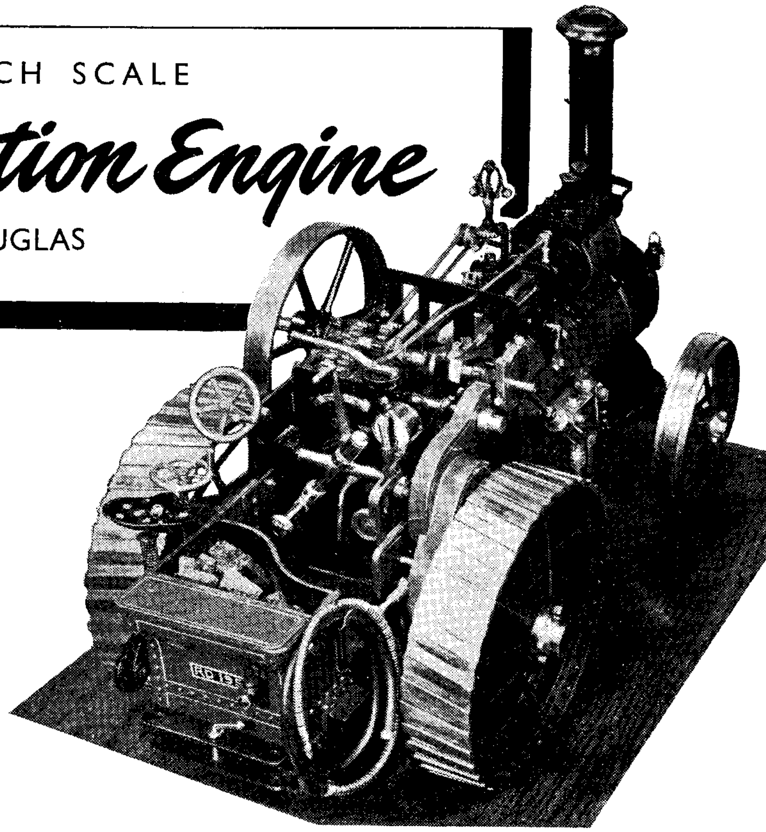
● WE LEARN that the Hayes and Harlington Model Engineers Society has changed its title to Harlington Locomotive Society. Its headquarters are at High Street, Harlington where the society's extensive track is situated, at the corner of Cranford Lane, within a few minutes' walk of the Harlington Corner (Coach & Horses) bus stop on the Bath Road.

We are informed that the track will be open, weather permitting, every Saturday from Easter till September, 1953, admission: adults, 6d.; children, 3d. There will be refreshment facilities.

A ONE INCH SCALE

"M.E." Traction Engine

By R. A. DOUGLAS



A LATENT desire to "have a go" became a possibility after returning home from an absence of many years of life in lodgings. An old round-bed Drummond lathe had been acquired for no particular reason, except that it appeared cheap. With this and precious little else, I decided to take the plunge, having caught the "disease" well and truly after attendance at one of the "M.E." Exhibitions.

The subject selected for my first attempt was a showman's engine which, although I knew little about it, has always fascinated me. How little I knew I only discovered after reading W. J. Hughes's excellent book *Traction Engines Worth Modelling*. Unfortunately, I acquired the book after modelling had commenced to the design of the "M.E." 1-in. scale blueprints. A single-cylinder, straked wheel showman's engine would not be respectable, and as I had proceeded to that stage, a conversion was impossible and, in any case, a little too ambitious.

The subject was therefore reduced to a single-cylinder traction engine, and this was carried to completion after 15 months of interesting spare-time work. The result is shown in the photographs which were taken by Catcheside Studios, York.

A first attempt did not warrant any great expenditure on tools or materials, so scrap was used to the limit of possibility. This explains in part why some rather unorthodox methods of construction were employed.

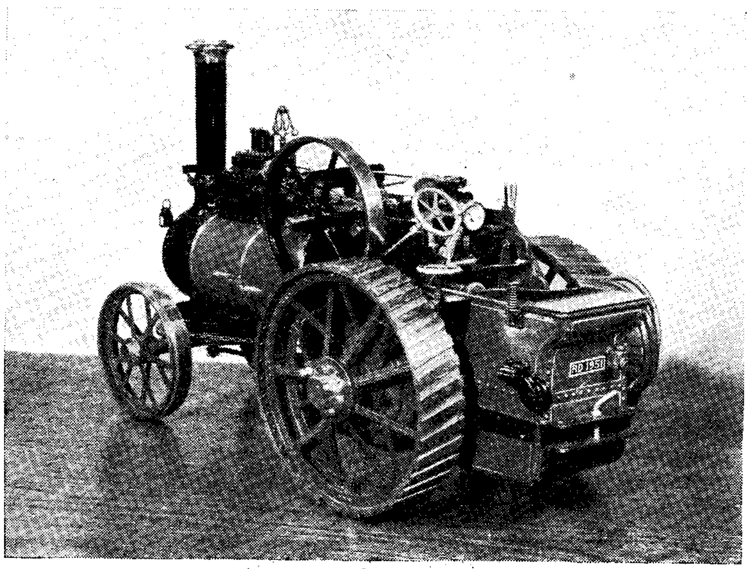
Although there are a number of faults in the model it does work well, and I have gained considerable experience in this class of work. The only difficulty in working the model is in maintaining a fire which does not cause the boiler to blow off steam and waste water.

The boiler barrel was made from the inside of a Minimax fire-extinguisher, but the firebox is steel with separate horn-plates (I know now they should be integral). The external joints were riveted and soft-soldered to maintain appearance, but the internal ones were brazed.

Although unusual, the boiler is still perfectly tight after many hours of steaming and a 200 lb. water test. I have no doubt its useful life will be curtailed by corrosion. The tender is also made from steel.

All the plates were hammered round steel formers whilst red-hot. The formers represented some hard work but were worth while.

The smokebox and ring were made in one piece from a scrap stub of



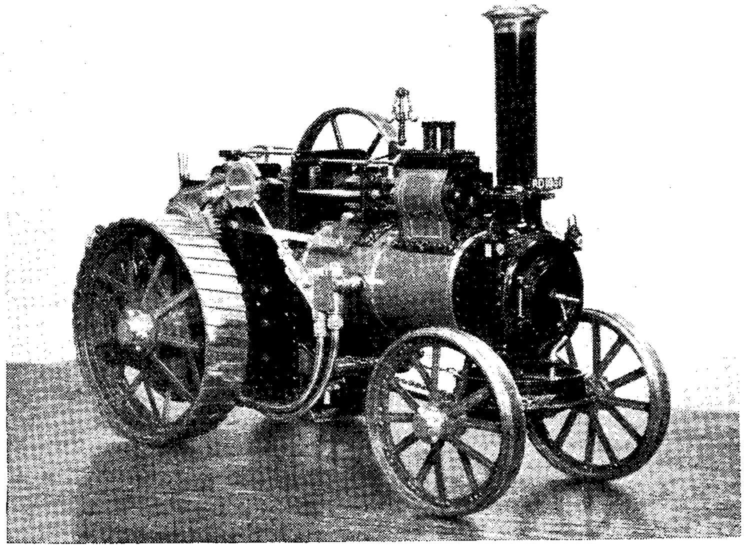
Three-quarter rear view showing details of the motion work and controls

steel shaft. It simply slides on an extension of the boiler barrel, the rivets being dummy.

Producing scale-size hinges for the toolbox lid appeared difficult if not impossible, but an effective alternative was made by soldering a length of $\frac{1}{16}$ in. rod to the back of the lid after reducing the diameter at two points near the extremities. Two strips of thin tin were then threaded through the gaps formed by the reduced sections, and bent round them and the ends closed together. The tags thus formed were then bolted to the back of the toolbox.

The valve and pump eccentrics and sheaves were made from steel scrap, and bushed with rings of bronze (one each side of a central rib) cut from old motor-car bushes. The construction is different from accepted practice, but avoids split liners and straps and the evils attendant in their construction.

The gears presented a problem, but were eventually made without difficulty from steel. The blanks were held in a home-made rig attached to the cross-slide and were cut with a tool carried in a boring bar placed between centres. One tool cut all the gears. It was ground with straight sides to match the space of an imaginary rack. An acceptable approximation to correct tooth form was produced by a method of generation. The teeth were first cut with a rack-form space between them. The blank was then moved laterally (by the traverse wheel), and also rotated slightly, the amount being calculated to correspond with the lateral movement, and a further cut taken. This process was repeated several times until the teeth assumed a respectable form.



View of the off-side of the engine showing the eccentric driven feed pump

Although a slower process than using a specially shaped tool, it does obviate the necessity of making one ; in fact, several different ones.

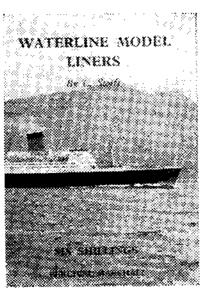
The cutting was carried out at the rate of one blank per two evenings, and the procedure simple enough to enable my wife to carry out, once the set-up was fixed. Incidentally, my wife assisted with most of the laborious work, such as reducing large chunks of scrap metal to near size, riveting wheels and boiler, etc, and for which I am duly grateful.

The award of a monetary prize for the model became her reward whilst mine was satisfaction.

Blueprints of the "M.E." Traction Engine can be obtained from The Model Engineer Plans Department, 19-20 Noel Street, London, W.1. price 15/6d. (four sheets) post free.

FOR THE BOOKSHELF

Waterline Model Liners, by C. Swift. (London : Percival Marshall & Co. Ltd.) Price 6s. net.



This very attractive little book will be welcomed by all who are interested in small waterline models of modern ships. The beginner will find it especially useful, and the expert will get profitable suggestions from its perusal. The tools and the various processes are fully described. Instructions are clear, and are arranged in orderly sequence, so that if the builder follows them he will find himself led step by step from the commencement to the finishing touches of his model. Useful hints are given on the building of the deck houses and on the making of the various fittings which mean so much to the realism of the finished model. The author has based his book on the construction of the model of the Cunarder *Queen Elizabeth* and the Canadian Pacific Steamship Company's *Empress of Canada*. The scale suggested is 1/64 in. = 1 ft., which in our opinion is a better scale than the popular 100 ft. = 1 in. Two folding plates are given of the *Queen Elizabeth* and one of the *Empress of Canada*, and in each case all the necessary details are fully shown. Owing to the size of the book, these plans are reproduced somewhat smaller than the finished model, but as the scale is given there should be no difficulty about this. Also, if the builder prefers a smaller or larger scale, he can alter his measuring scale accordingly. The drawings throughout the book are made by the author and by their clearness add greatly to its value. The author's methods are applicable to other ships and a list of plans of various ships is included in the book. These drawings, which are obtainable from the offices of the publishers, are notable for their wealth of accurate detail, and this feature of the author's work is reproduced in his book.

The frontispiece is an excellent broadside view of the *Queen Elizabeth*. There is also a very useful aerial view of the *Empress of Canada*, and other photographs of the two ships, and three photographs of Donald McNarry's model of the *Queen Elizabeth* which won a silver medal in the "M.E." Exhibition, of 1948.

The book is well produced, and at its moderate price, should find a place in every shipmodeller's library.

Talking about Steam—

NO. 13. THE FOWLER "BIG LION" ROAD LOCOMOTIVE

By W. J. HUGHES

IN the last article, we discussed and illustrated the Fowler cylinders, and how the steam passages were arranged. You may recall also that in my description of the traction engines at THE MODEL ENGINEER Exhibition, I mentioned that Mr. Taylor had made special patterns and coreboxes for the cylinders of his Fowler, so as to work in the passages and sloping valve-faces correctly.

However, it is possible to fit in the passages, and the sloping valve-faces, too, without going to all that trouble. (Incidentally, not many model engineers would have the necessary knowledge of foundry practice to do the job in the orthodox manner.)

In Chapter XI of my traction-engine book I have suggested ways and means of drilling the rather complicated passages, and am pleased to say that Mr. Stanley N. Green, of Calgary, Alberta, has very kindly sent me full details of his cylinders, the passages of which are arranged according to my suggestions.

A Worthy Brother of the Craft

Not only has Stan sent particulars, including drawings, of these, but he has included many other details which will be dealt with in due course. In addition, he has sent along the *patterns* for the cylinder castings, so that others may benefit by this, too. It is from these patterns that Bro. Reeves, of Birmingham, is producing castings, and those shown in photograph No. 16 are the first sample set.

But besides being thus generous to a degree, Stan Green is building what should be, when finished, one of the finest "Big Lions" ever, as his photographs show. This is further borne out, incidentally, by another traction engine enthusiast in Alberta, Mr. Ashley Butterwick, who told me that Stan's craftsmanship is of the highest, and well worth driving the more-than-150 miles from his home to see. (Ashley is building a large-scale compound Burrell at present, and I am hoping to receive pictures of that soon).

The Photographs

In the photographs, of course, the parts are mostly just "put together" for the purpose, and not properly assembled; nor do they represent all the work done to date by any means. The side view shows how the proportions are being well-preserved, and you will notice how the hornplates are machined out to take the circular and part-circular spigots on the bearing brackets.

Photograph No. 18 shows admirably the detail of the chimney with its hinge to the well-shaped base, and also the nice shape to the cylinders; note the annulus bored half-way along the L.P. bore, the reason for which will be seen in due course. The next photograph shows the details of the front axle and perch bracket, with the spring, spud-pan, push-pole bracket, and steerage chain shackles, most of which were mentioned when the front axle was dealt with.

Stan Green, by the way, was originally a railway locomotive fan, and I have some photographs of an excellent Stirling single-wheeler and a fine "Princess Royal" which show his prowess in that direction. The Fowler is his first attempt at a road locomotive or traction engine.

Model Cylinders

Reverting to the cylinders, however, I am first reproducing the drawings and condensing the suggestions from my book. It should be remembered that these drawings were only offered in the book as suggestions, and that the passages and ports are not to scale.

In this scheme, instead of the valve-faces sloping both inwards and forwards, which would not be easy to machine, the face only slopes in the forward direction, and is flat right across. Further, to ease the machining problem, a separate steam-chest is employed, being shaped to fit in with the top of the

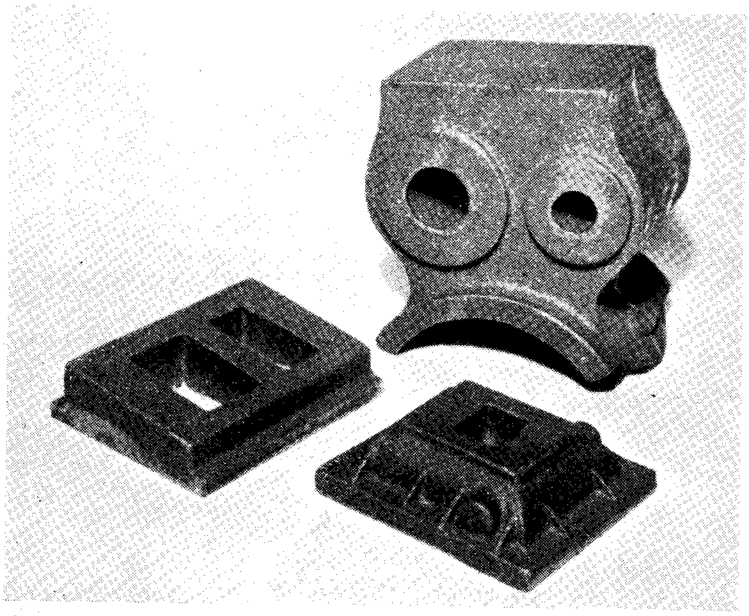
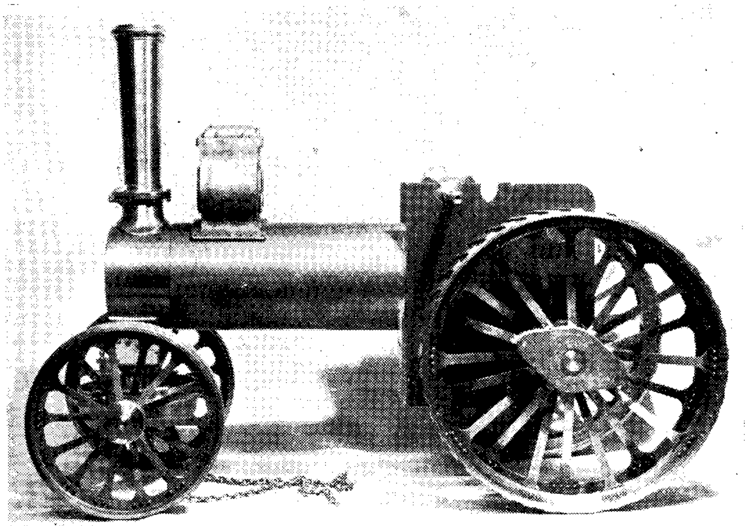


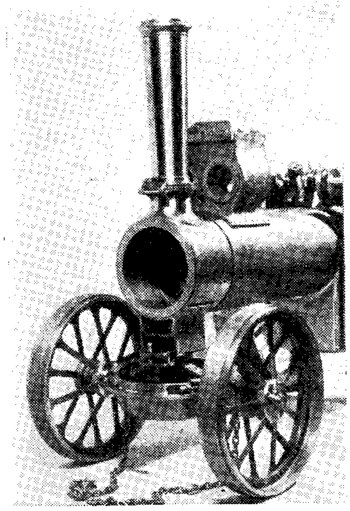
Photo by] [*The author*

Photograph No. 16. A set of castings for the cylinders of the Fowler "Big Lion," submitted by A. J. Reeves & Co.

Continued from page 778, Vol. 107, December 11, 1952.



Photograph No. 17. *A fine 1½-in. scale model of the " Big Lion " which is being constructed by Stanley N. Green, of Calgary, Alberta*



Photograph No. 18. *Three-quarter front view of Mr. Green's model: note annulus in L.P. bore, before insertion of liner*

cylinder-block. Above this is the dome casting.

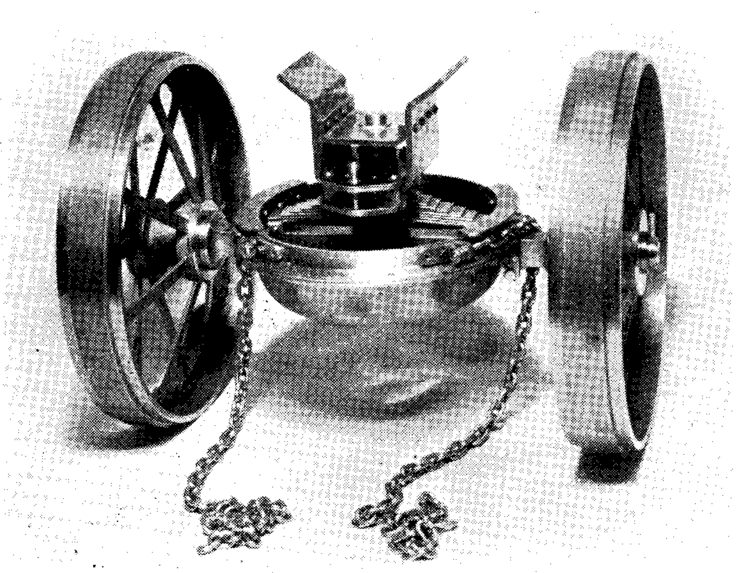
Actually, in the photograph of Reeves' castings, it will be seen that, as cast, the top of the cylinder (the valve-face) is horizontal in *both* directions; this is for ease of setting-up for machining the cylinder-bores and the underneath saddle. Afterwards, of course, it is machined off at the correct angle.

Fig. 48 is a cross-section of the arrangement. Steam passes from the boiler into the cavity at the base of the cylinder block, and thence up the drilled passage *S* to the dome cavity at the top, over which the safety-valves sit, of course.

Looking at the inset, a passage is drilled and reamed from the front, in which the regulator valve works—this latter is a hollow piston. Steam passes down drilled passage *A* to the regulator-valve, which closes the passage when pushed in. When in the position shown, the valve is open, and steam passes through a hole drilled in the valve, and down passage *B* to the governor-valve, which is also a piston (shown in the open position). This also works in a passage drilled from the front, and through into the steam-chest. Passage B is drilled from the top, and blocked with a screw-plug.

Now, in Fig. 49 (A) and (B), the inlet and exhaust passages are shown. A liner is fitted to form the cylinder-barrel, and the ports are milled or drilled and chipped in the usual way. From the bottom of these, steam-passages are shown machined above the liner (before it is fitted, of course !) ; this could be done with a milling-cutter. On the other hand, the steam-passages may be drilled in the usual manner, which is what Stan Green has done.

To meet the exhaust port, the annular recess *R* is machined, also before the liner is fitted, to act as the " receiver," in conjunction with the L.P. valve-chest; the connection between the two is by way of the drilled holes *E* (Figs. 48 and 50)



Photograph No. 19. *Front axle and perch-bracket assembly, showing many of the details referred to in a previous article*

The Low-Pressure Side

On the L.P. side, the ports and steam-passages are as on the H.P. side, and a similar annulus is bored into which the exhaust port leads. The exhaust passage is drilled from the chimney end or back of the block; and from the side of the block a

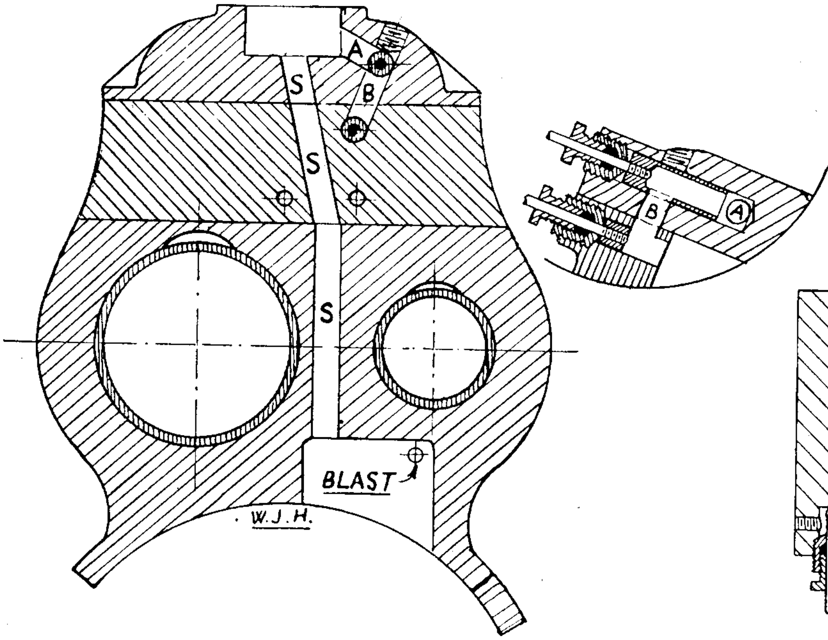
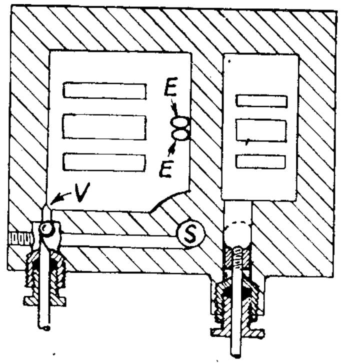


Fig. 48. Suggested method of arranging some of the steam passages in the "Big Lion" cylinder block



hole is drilled diagonally to meet it, passing through the annulus. The outer end of the passage is blocked by a screw plug, as shown in Fig. 50. A liner forms the cylinder barrel as before.

To arrange the simpling-valve, a small chamber is drilled from the front of the valve-chest, with its bottom flattened by pin-drilling. To connect the chamber with the high-pressure steam, a passage is drilled sideways to join up with passage *S* (see plan, Fig. 48), its outer end being screw-plugged. The chamber is connected to the L.P. chest by a small port *V*, on which a ball is seated. Normally the steam pressure will hold the ball on its seat, but when the oblique-ended rod is pushed, the ball will be de-seated, and high-pressure steam will enter the L.P. chest. (In actual practice the chamber would be rather smaller in diameter, and *V* slightly off-centre in the direction of *S*).

Another alternative for the simpling-valve would be to use a hollow piston-valve similar to the regulator-valve. This would perhaps be easier and simpler to make.

Glands

As shown, glands for the three valves would need separate nipples or stuffing boxes screwed in, in order to form a bottom for the packing-material. The glands illustrated are of the screw-in type, but the oval type with two studs and nuts would be more correct and much better-looking.

Dimensioned Drawings

Fig. 51 shows dimensioned details of the model cylinders, and has been made from drawings which Stan has specially prepared for these articles, along with others to appear later. By the way, readers who compare these drawings with my general arrangement blueprint of the prototype will find that certain of the dimensions have been slightly increased, but that, of course, is due to the exigencies of modelling. When the model is complete, only "L.B.S.C.'s" Inspector Meticulous would notice anything wrong—and even then he'd probably miss it if nobody pointed it out. The dome cover is shown in Fig. 52.

The valve travel in full gear is $\frac{1}{4}$ in., giving a cut-off of approximately 80 per cent. The stroke is $1\frac{1}{2}$ in., and the H.P. cylinder is bored 1 in. diameter, with a liner 3/32 in. thick to give an effective bore of $\frac{13}{16}$ in., which is scale size, near enough.

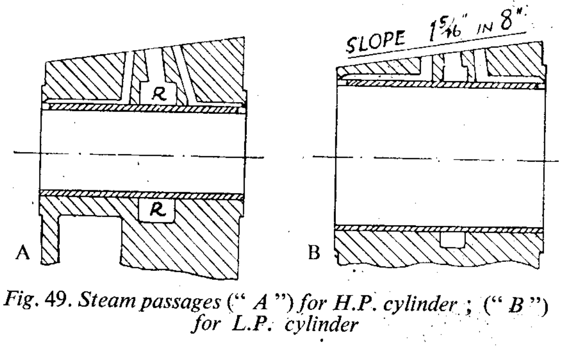


Fig. 49. Steam passages ("A") for H.P. cylinder; ("B") for L.P. cylinder

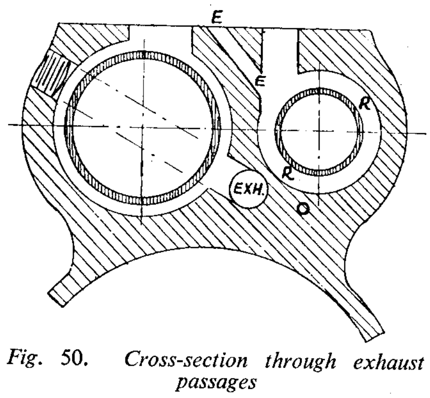
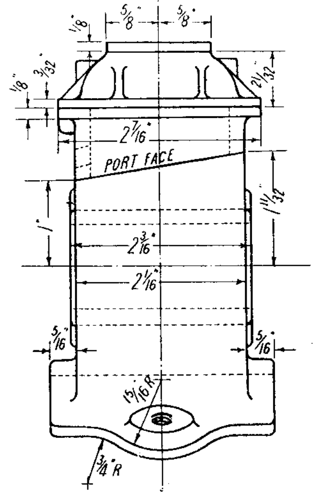


Fig. 50. Cross-section through exhaust passages



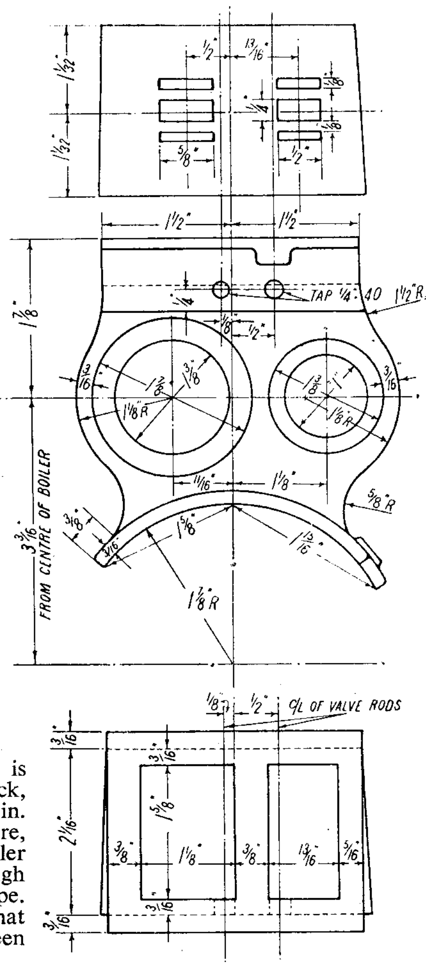


Fig. 51. *Details of model "Big Lion" cylinders sent by Stanley N. Green, of Calgary*

The bore of the L.P. cylinder is $1\frac{3}{8}$ in., with a liner $\frac{1}{16}$ in. thick, giving an effective bore of $1\frac{1}{4}$ in. This is less than the scale bore, but is advisable because the boiler is not designed for such a high initial pressure as the prototype. In turn, of course, this means that there will be less expansion between the H.P. and L.P. stages.

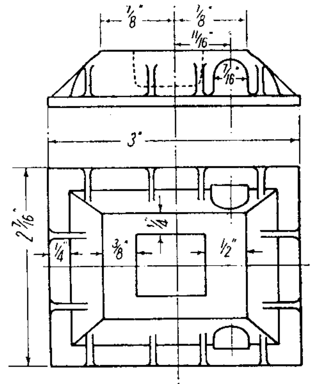


Fig. 52. *Dimensions of dome-cover*

Talking about boiler pressure, this is 120 p.s.i., and should not be less, in my opinion, for a compound. If it is, the L.P. cylinder will not do sufficient work to justify the extra complication. Moreover, it must be remembered that the cylinder has to exhaust against an atmospheric pressure of 15 p.s.i.; if the absolute pressure of the L.P. exhaust steam falls below that pressure, it cannot even crawl out of the cylinder, let alone work the blast.

In the next article I propose to give further particulars of these cylinders, and then to follow up with some photographs and a brief description of some very ingenious fabricated cylinders made by Mr. R. S. Jaques, of Boston, Lincs, whom I was fortunate enough to meet at the Manchester Exhibition of the N.A.M.E. early in 1952.

An Eye-opener

IT was at a bolt and nut factory on the border of the "Black Country" that the following incident took place.

An order had been received for a fairly large quantity of curved washers to "bed" to the outside of telegraph poles, and strange to say, the firm had been in business for many years. This was the first time an order of this particular class had been received, and in the words of the manager, "There was nothing in it."

So it was decided to do the "curving" of the washers under the "Oliver" (this being a foot-operated hammer), top and bottom swage tools being made of the correct radius, and proceedings commenced. Was it successful? It wasn't. Instead of the expected curve, it turned out as a well-rounded vee (at the bottom), and naturally caused disappointment.

Among the onlookers was an old and "queer" hand who went by the nickname of "Si," his proper name being Josiah. After looking on at the repeated failures, he at last said in pronounced Staffordshire dialect to the assembled "Heads," "What bin you trying to do?" "Well, we're trying to curve these washers," said the foreman with a red face. "Well, that ay the way to goo about it," says Old Si. "Oh," said the manager, "perhaps you can show us." "I can that," says Si with a grin on his face. "If you'll gi' us a chance."

Now how was it done? Well, the first attempt had been made by placing the washer central in the bottom tool and striking it a single blow with the hammer holding the top tool—and the result was failure.

Old Si picked up his first washer and placed it on one side of the tool and struck it with the hammer. *Blow No*. 1. He then removed the washer to the other or opposite side of the bottom tool and struck again. *Blow No*. 2. And, finally, the washer was placed in the centre of the bottom tool and struck *Blow No*. 3. This produced a satisfactory result. After picking up the washer and examining it rather critically, old Si handed it to the foreman with the remark, "That's as near as you'll git it"!

—P. ROBINSON.

A high-speed sensitive drilling machine

By the Rev. Arthur Mellows

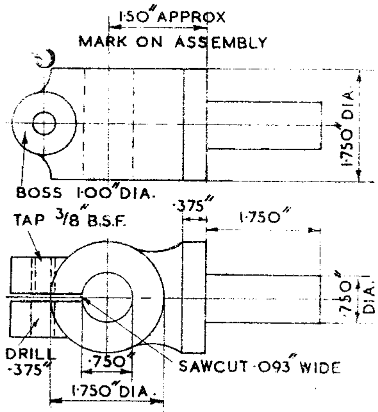
THE smaller of the two cone pulleys has a boss which is pressed into the Hoffman bearing LS8. This bearing, it will be noted, has its housing in the top boss of the headstock. It will be seen, therefore, that the spindle simply slides through the pulley, deriving its rotary movement from a key sliding in the long keyway. This key is held in position by a cover plate which also forms the top flange of the pulley. This arrangement was in the nature of an experiment to try to relieve the actual drilling spindle of all belt strain, and has been found to be very satisfactory in service. The belt guard is built up from two pieces of mild-steel plate, cut and filed to shape, and silver-soldered to a cup which acts as a grease-retaining washer for the bearing, LS8. I have drawn a section drawing of this arrangement which I hope will make matters clear, but a further word about the actual assembly of these various items may help. First, the bearing is pressed into place; it is then charged with grease. Then the belt guard is put into place and screwed down. The pulley is then drawn into the ball-race with a draw-bolt which passes through its length. The drilling spindle is then slid into place from below. The key is then inserted in the keyway and the top flange of the pulley screwed down.

Equal Belt Tension

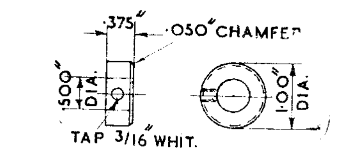
The jockey pulley arrangement has been designed to give equal belt tension at all speeds, and also to make sure of correct alignment of the belt; this is, of course, a most important consideration if the maximum efficiency is to be obtained. Nothing can be more aggravating than a belt which either slips or comes off at the critical moment. In practice, the arrangement works very well, and has amply repaid the considerable amount of work involved. From the headstock casting there is a stalk which carries a steel-slide. Upon this slide is carried the spindle. This consists of a rectangular section of steel turned down at either end to 0.500 in. diameter. The short sliding bushes for the ball-races, Hoffman LS10, move endwise upon these diameters and are prevented turning by Woodruffe keys. Collars at either end restrict the longitudinal movement of these bushes and so prevent the wheels coming off. All these details are shown in the drawings, but there is one very small refinement which may seem unnecessary. It is the 0.375-in. slot cut throughout the length of the steel slide. This slot forms a bearing for the locking key, and it is intended to prevent the slide becoming burred up by the tightening of the locking-screw.

The operating pinion and shaft were turned in one piece, partly to

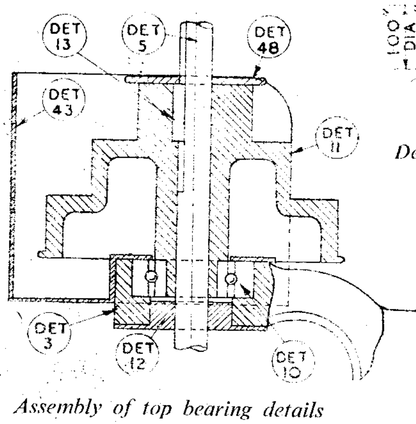
Continued from page 8, January 1, 1953.



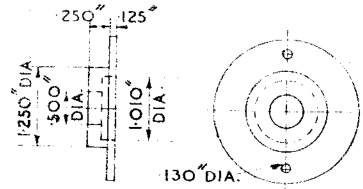
Detail 36—1 off, cast-iron



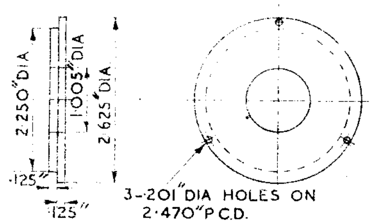
Detail 26—2 off, mild-steel



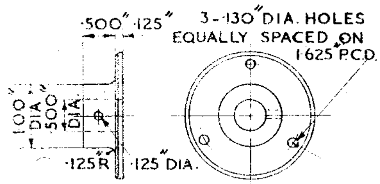
Assembly of top bearing details



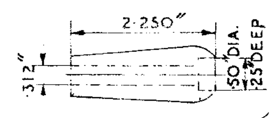
Detail 12—1 off, brass



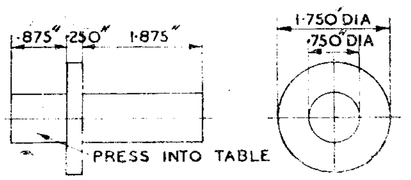
Detail 25—2 off, brass or mild-steel



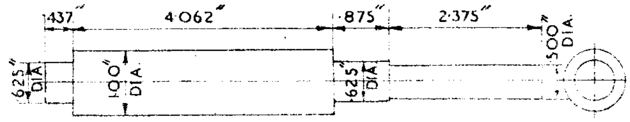
Detail 15—2 off, phosphor-bronze



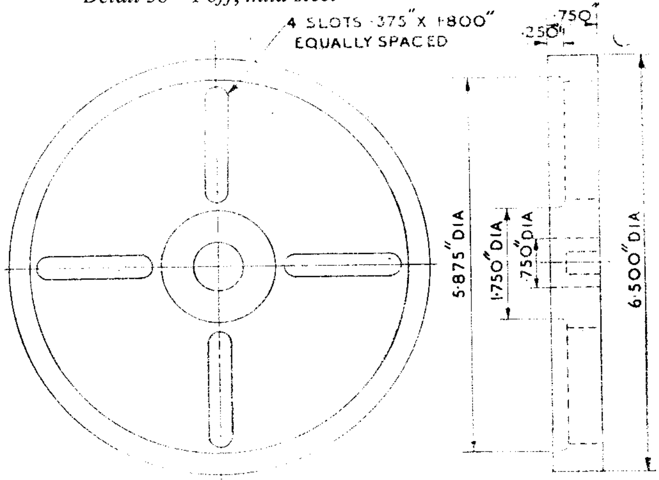
Detail 17A—2 off, ebonite



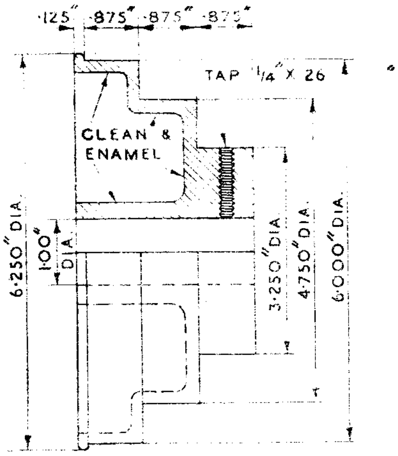
Detail 38—1 off, mild-steel



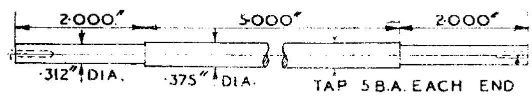
Detail 31—1 off, mild-steel



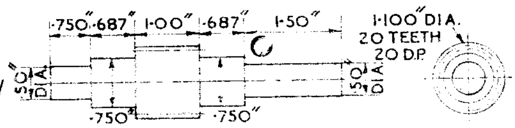
Detail 35—1 off, cast-iron



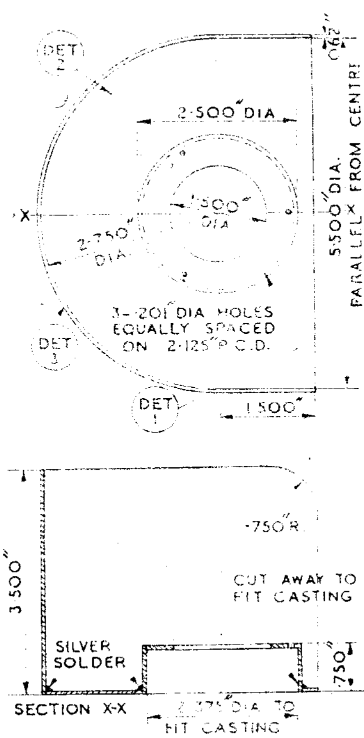
Detail 30—1 off, cast-iron



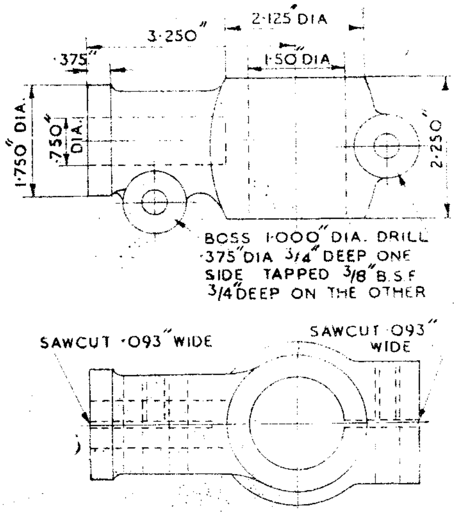
Detail 17—1 off, mild-steel



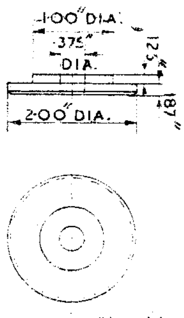
Detail 14—1 off, mild-steel



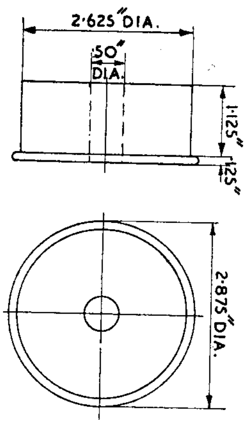
Detail 43—mild-steel



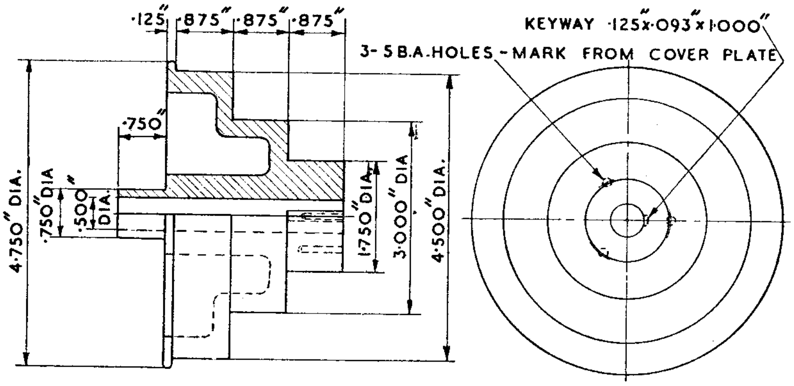
Detail 37—1 off, cast-iron



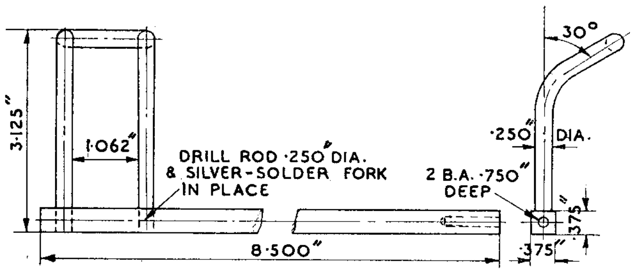
Detail 18—1 off, mild-steel



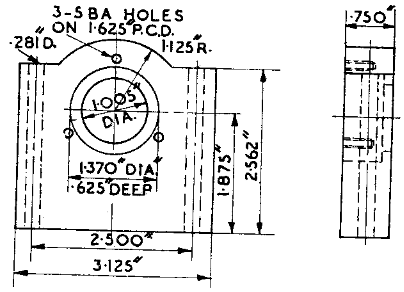
Detail 32—1 *off steel or cast-iron*



Detail 11—1 *off, cast-iron*



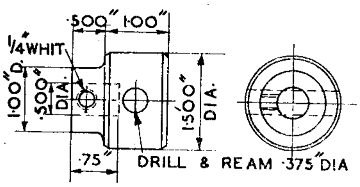
Details 45, 46—1 *off each, mild-steel*



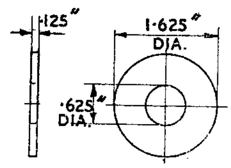
Detail 27—2 *off, mild-steel*

SCHEDULE OF DETAILS FOR DRILLING MACHINE

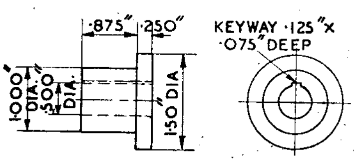
Detail	*Name*
1	Baseplate
2	Pillar
3	Headstock
4	Sleeve for spindle.
5	Spindle.
6	Thrust-bearing, Hoffmann W¾.
7	Ball-bearing, Hoffman S7.
8	Thrust washer.
9	Thrust-nuts
10	Ball-race, Hoffman LS8.
11	Cone pulley for spindle.
12	Cover plate for bottom of pulley housing.
13	Steel key to drive spindle.
14	Pinion and operating shaft.
15	Bearings for pinion.
16	Knob.
17	Handle.
17*a*	Ebonite ends for handle.
18	Washer at top of column.
19	Bearer for belt tension.
19*a*	Stalk for bearer.
20	Shaft for belt tension pulleys.
21	Jockey pulleys.
22	Ball-races for jockey pulleys, Hoffman LS10.
23	Sliding shafts for ball-races.
24	Woodruffe keys for shafts.
25	Cover plates for jockey pulleys.
26	Collars for shaft 20.
27	Countershaft bearing housings.
28	Ball-races for countershaft, Hoffman LS7.
29	Cover plates for detail 27 and 28.
30	Cone pulley for countershaft.
31	Countershaft spindle.
32	Fast pulley.
33	Loose pulley.
34	Ball-races for loose pulley.
35	Table.
36	Swivel clamp.
37	Table clamp to column.
38	Stalk for table.
39	Clamp-screws.
40	Studs for countershaft bearings.
41	Tension spring.
42	Retaining cap for spring.
43	Belt guard.
44	Striking gear brackets.
45	Striking gear rod.
46	Striking gear fork.
47	Knob for striking gear rod.
48	Cover plate for cone pulley.



Detail 16—1 *off, mild-steel*



Detail 8—1 *off, mild-steel*



Detail 23—2 *off, mild-steel*

save a multiplicity of parts, but chiefly because it was more convenient for the gear-cutting process. This was done with the help of the dividing head which I described in these pages in the issues of September 17th and 24th, 1942. With this tool, it was a simple matter to get correctly cut teeth: a 20 d.p. cutter being run between centres in the lathe, and the work held in the collet of the dividing attachment. Other readers who may not possess such a useful accessory will have to borrow the 20-tooth change gear from their lathe and use this for spacing.

Maximum Leverage

The operating handle is free to slide up and down in the knob. This gives maximum leverage at every point. It may, however, be an advantage to provide for a locking-screw to fasten the handle when using the very small diameter drills.

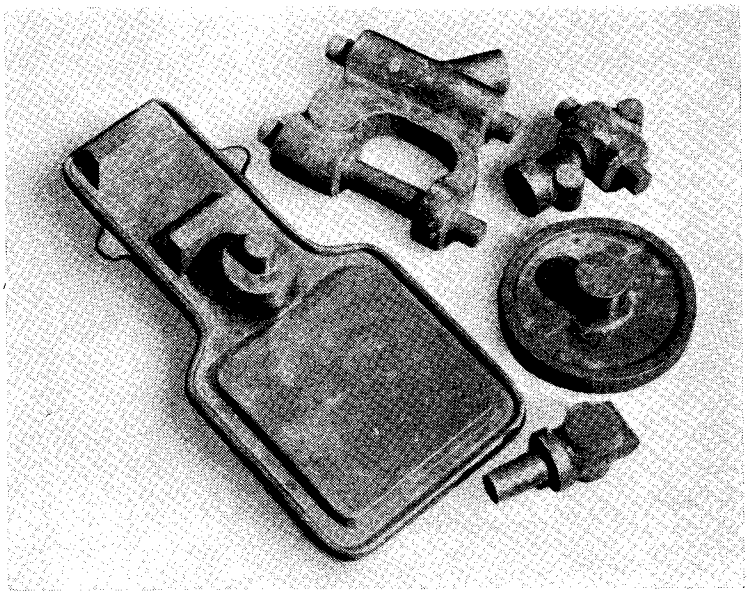
Trouble-free

Spring loading of the spindle has been achieved in what was considered to be the most trouble-free method; the spring is interposed between the driving cone pulley and a cap at the top of the spindle. At first it was feared that centrifugal force might interfere with the correct working of the arrangement, but in actual practice this is not the case. The arrangement, moreover, has the advantage that a heavier spring can readily be fitted in place, should one develop "heavy handedness." Trial and error with a good number of springs brought me to the following data *which is suitable in my own case* and which should be used only as a starting point for investigation in all other cases. The spring is wound left hand and has an internal diameter of 0.510 in. Its free length is 6 in. and it consists of twenty-two turns of Brunton's steel wire 0.062 in. diameter.

Double Swivelling

The table support and column clamp is arranged to swivel in two directions ; first, about the column to allow for bringing holes into centre or moving the table out of the way altogether; second, in degrees to provide for angular drilling. The column clamp was bored and faced in the four-jaw chuck, care being taken to get the 1.500 in. diameter as smooth as possible. It was then mounted upon an angle-plate bolted to the faceplate of the lathe and bored, faced and turned for the swivel clamp stalk and for the degree index. The swivel clamp was then turned between centres to fit the 0.750 in. diameter bore in the column clamp, and its two faces of the table clamp were faced parallel with one another. These items were then assembled on the column and a straight-edge clamped to the upper face of the table boss. The extreme points of this straight-edge were then clocked up to zero with the base table, and the working centre was found by running a Slocombe drill in the chuck. A 0.250 in. diameter hole was then very carefully drilled right through the casting and a mandrel inserted in the hole. The casting was then set up in the four-jaw until the mandrel ran absolutely true. The hole was then bored out to receive the table stalk. In this way it was made certain that the centre of the table coincides exactly with the centre of the drill in the chuck. Graduation of the swivelling clamp was done in the dividing head; every five degrees being marked. These are numbered 0-90, 90-0. The table was next put into its place and clocked up parallel with the base table. Zero markings were then stamped on the column clamp coinciding with the 0's on the swivel.

The remaining work on the machine was quite easy and straightforward turning and fitting, and calls for no comment. Readers will find all necessary dimensions in the drawings.



The patterns used in the construction of the sensitive drilling machine

Finishing

Before assembly, all the castings were given three coats of cellulose primer, each item being carefully rubbed down between each coat. The machine was then assembled and all the bright parts protected with lanoline and paper. Two coats of black cellulose enamel were then applied with the spray gun. Finally, the machine was polished down with cellulose polish and finished off with Simoniz.

Belting

A $\frac{3}{8}$-in. flat leather belt is used on the machine and it has been found quite in order to make the joint of this with "Klincha" wire lacing. Power is taken from the lineshaft by means of a 1-in. leather belt. On the first speed there is a slight drop in revolutions when using a 0.312-in. drill, but this does not prevent easy drilling. At the other speeds and with all other sizes of drills, there is no appreciable slowing up. Measured with a "Hasler" revolution counter the speeds are 700, 1,500 and 3,300 r.p.m., which is considered to be sufficiently near to the estimated speeds as to warrant the conclusion that almost 100 per cent. efficiency is being obtained. The measured accuracy of the machine is rather closer than the prescribed limits, and in use the machine is a delight to work. Drilling has at last become a pleasure !

SQUARE-HEADED SCREWS

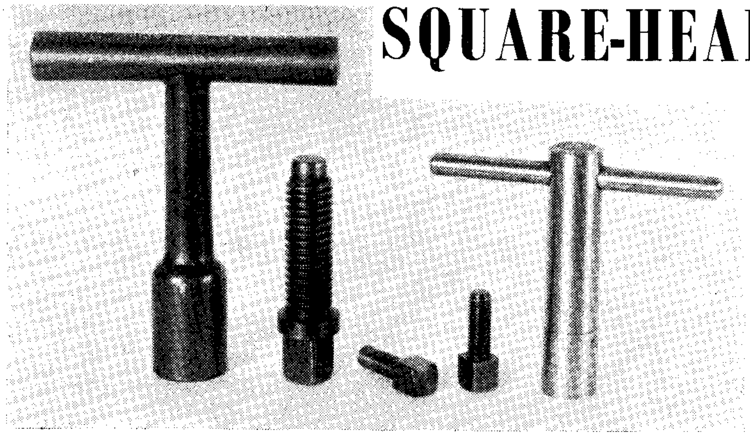


Fig. 1. Left—a square-headed cap-screw and key ; Right—plain square-headed screws and jet key

ALTHOUGH Allen cap-screws are now largely used for such purposes as clamping the tools in lathe saddle turrets, the square-headed screw still survives, largely, perhaps, because the key can be so readily applied, and affords a constant leverage, even in awkward places.

The simplest example of this kind of screw is that shown in the centre of Fig. 1 ; here, the threaded shank is formed directly on the squared head. When making these screws a length of square steel rod is selected to fit into an existing key formed with a corresponding square socket. In this connection, the key at one time supplied for removing the jets of the Zenith carburettor is a good working fit on $\frac{1}{4}$ in. square material, and the key used for adjusting the stop-valves of hot water radiators has a square socket $\frac{5}{16}$ in. across the flats.

Screws with plain square heads are easily made by centring the length of square material in the four-jaw chuck, and then parting it off to length after the shank has been turned and threaded with the aid of the tailstock dieholder. The tip of the screw should be deeply chamfered, to prevent burring and spreading of the threads when the screw is in use and is tightened on the work.

The screw is next reversed in the chuck for facing and chamfering the upper surface of the head. If the finished screw does not fit easily into its key, it should be lightly driven in for a short distance, and the resulting pressure marks will then show where the head flats have to be filed down so that the screw will fit into the key in all positions.

The appearance of the screw will be enhanced if it is finally blued by heating, until the required colour is obtained, and then dipped out in oil. Where the screws are subjected to wear, it is advisable either to make them of carbon-steel and then harden and temper, or to case-harden if mild-steel is used.

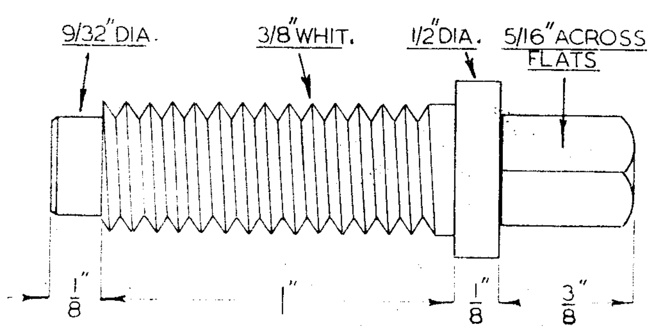
Square-head Cap-screws

The cap-screw shown, together with its key, on the left of Fig. 1 has a rather more workmanlike appearance, and it also has the advantage that the key is located by the projecting collar which keeps the key from engaging further than is necessary to obtain a secure hold.

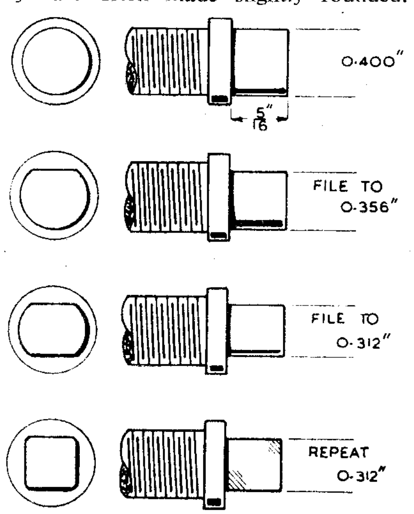
For making screws of this kind, a length of round steel is selected, having a diameter rather greater than the distance across the corners of the finished square head.

A working drawing of the screw illustrated in Fig. 1 is given in Fig. 2. The $\frac{1}{2}$ in. diameter round material is gripped in the self-centring chuck and the shank is turned and threaded; in addition, the end of the thread is relieved for a short distance and a light finishing cut is taken over the collar portion.

If a batch of screws is being made, they should all be machined in this way and parted off to length. After the screw has been reversed in the chuck, the head is turned to a diameter slightly less than the length of the diagonal of the square, say, 0.4 in. for a $\frac{5}{16}$ in. square head having a diagonal equal to 0.44 in.; this is to ensure adequate clearance, as the corners of the socket in the key are often made slightly rounded.



Above—Fig. 2. Showing the dimensions of a $\frac{3}{8}$-in. Whitworth square-headed clamp screw



Right—Fig. 3.—Stages in filing a square screw head

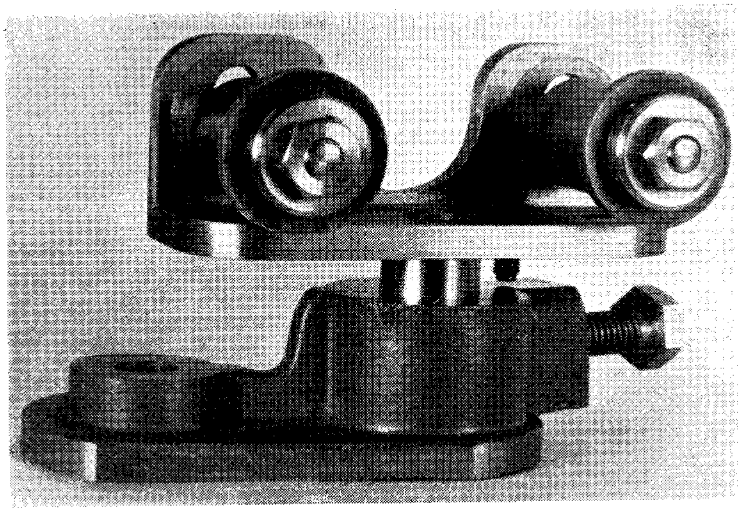


Fig. 4. A filing rest mounted in the lathe hand rest

The two patterns of filing rests illustrated have been described in this journal, together with particulars of their construction.

The first, shown in Fig. 4, is mounted in the lathe hand-rest bracket which is designed for clamping to the cross-slide. The height of the guide rollers is adjusted by means of a fine-thread, hexagon-head screw. The other rest, Fig. 5, is attached to the vertical-slide, as shown in Fig. 6, and the height setting is made with reference to the index collar fitted to the feed-screw controlling the slide. In either case, the hardened rollers are shouldered in order to provide a guide face for maintaining the file at the correct distance along the work.

At the start, the height of the rollers is set to bring the file into level contact with the work and the

To complete the machining, the surface of the head is faced and then chamfered.

Forming the Square Head

There are several ways of forming the squared portion; either by filing in the vice, by making use of a lathe filing rest, or by a milling operation in the lathe.

At the outset, the diameter of the cylindrical head portion should be measured with the micrometer; as suggested, this should be 0.4 in. for a $\frac{5}{16}$ in. square head. Now, as 0.4 in., less $\frac{5}{16}$ in., equals 0.088 in., 0.044 in. must be removed from each of the four sides to bring the head to size and make it central on the shank. The first side is, therefore, filed down parallel until a micrometer reading of 0.356 in. is obtained. The opposite flat is next filed in the same way to reduce the diameter to 0.312 in.

The parallelism and squareness of the two flats can be checked during filing by applying the micrometer at both the ends and the sides of the filed surfaces. To finish the head to size, these operations are repeated on the two remaining sides, and their squareness is checked with a small try-square. Any further fitting needed is carried out in the way described for making the simple form of square-head screw.

The Lathe Filing Rest

With ordinary care, there should be no difficulty in forming the screw-heads accurately to shape by hand filing, but the work will certainly be more easily and quickly carried out in the lathe with the aid of a filing rest.

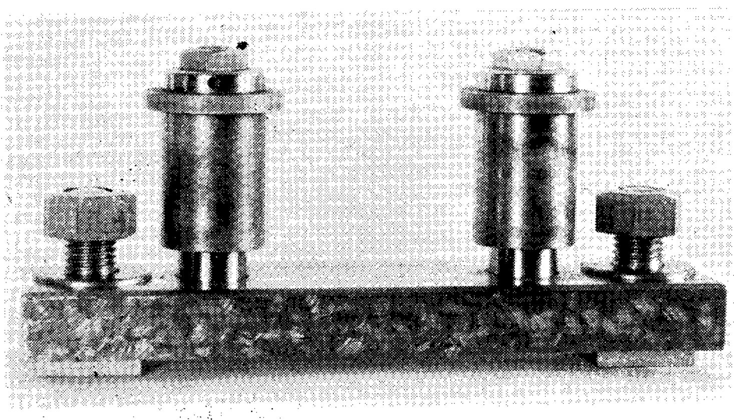


Fig. 5. The detachable filing rest

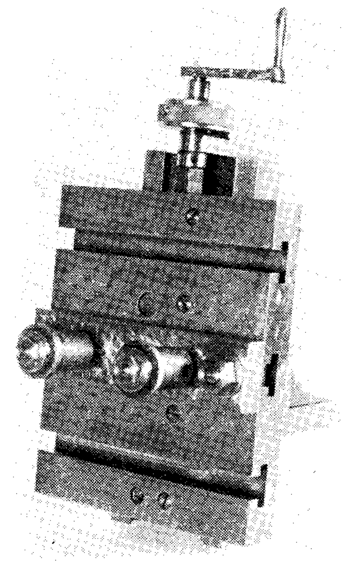


Fig. 6. The filing rest mounted on the vertical slide

rollers. The rest is then lowered with the feedscrew for the full calculated distance.

For this work, it is best to use the kind of file known as a hand-file, which has parallel sides and one safe-edge.

Before starting to file, a 20-tooth or a 40-tooth change wheel is secured to the tail of the mandrel, and a detent is fitted to the quadrant to enable the work to be divided into four with the mandrel firmly locked.

After filing has been continued until the file ceases to cut, the detent

(Continued on page 45)

A Model of the

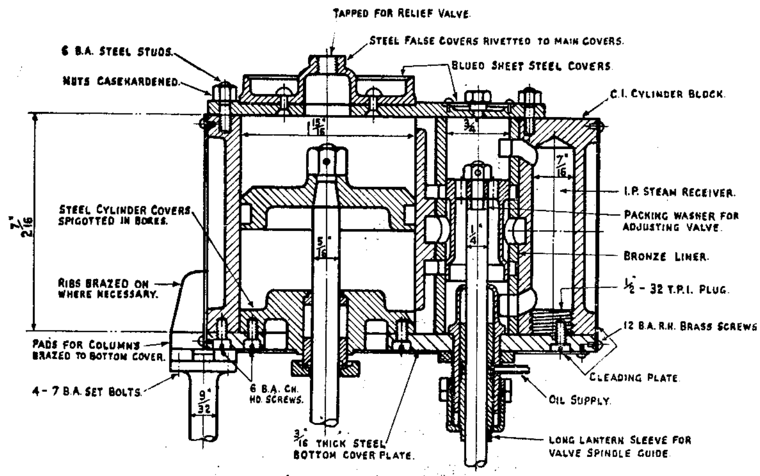
Savery Launch Engine

By A. W. G. Tucker

FIRST, I must say how delighted I was to have been awarded the Championship Cup for the General Engineering Section at the recent MODEL ENGINEER Exhibition. It has been an ambition of mine for a few years now, and to have been successful this time just puts the seal of satisfaction on my engineering efforts. I was awarded a Silver Medal at the 1922 show for my 2-in. scale compound steam tractor, a machine that bristled with so many novel features and ideas that I am sure would turn our present-day scribes on traction engines hairless. In 1947, my locomotive *Lady Anna* collected a Silver Medal, and in spite of all the criticism levelled at its Holcroft gear, still gives eight very evenly spaced beats, which are quite audible when the locomotive is starting with a fair load.

Happy Memories

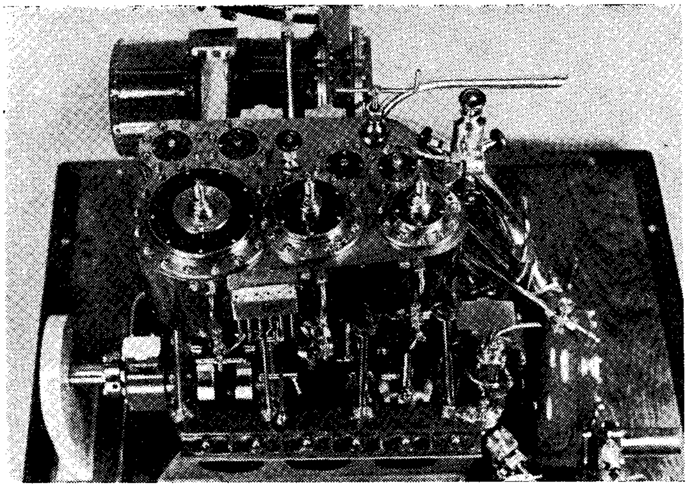
This triple-expansion engine has taken me about four years to make and has awakened in me many happy memories. For years I have always been interested in the sight of the two or three steam launches tied up in the Avon at Tewkesbury, near the Old King John Bridge. I had occasion to go to Tewkesbury during the war period, and found the little shipyard a hive of activity; I saw one of the launch's boilers close to the roadway, set up for steaming timber from which to bend the frames. Not far away under a tarpaulin was something that looked suspiciously like one of the engines. This indicated to me that here was one of the few steam launches going west. About the year 1947—I happened to be spending the night at Tewkesbury, and found out that the last survivor, the S.L. *King*, was still in commission, and running regular trips up the Avon; so next morning, we treated ourselves, and the first thing I did on going aboard was to gaze down the partially opened skylight. There, a wondrous sight met my eyes, a lovely little triple with piston valves on all cylinders, beautifully kept, and a book of history inscribed on its polished brass nameplate which circled the L.P. cover: "T. A. Savery, Newcomen Works, Birmingham." It only wanted James Watt Street to make it complete. I decided there and then that this was to be my next attempt, the 2-8-0, 0-8-2 Garratt could go on the shelf for a spell, anyway. So on my return I contacted Messrs. T. A. Savery, found they were still very much in business, and if I would wait until they had collected their dispersed drawings, I could come down and they would loan me what drawings I wanted. I was duly notified by Mr. A. H. Westwood, a director of the concern, that the drawings were now ready for my inspection, and I spent a most delightful time going over them, and found their officials most helpful and highly interested in my project. I was not able to find any drawings of the "King" engines, but those of a more modern example, and of which most detail drawings were available. They were also, most fortunately for me, able to find a catalogue of the period, and the engine I chose was a standard size, listed as a 90 h.p. engine, and sold complete with its water-tube boiler, all fittings, shafting and propeller, for the sum of £900.

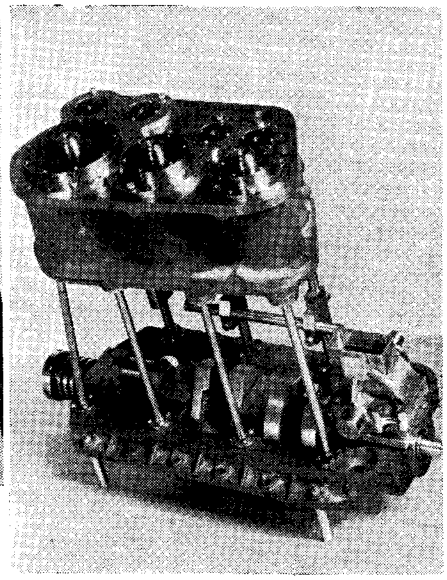


Section through I.P. cylinder and valve

Cylinders

I had photostat copies made of all the drawings, and from these made my own working sketches; I had to make a few minor alterations to eliminate some of the difficult parts of the engine when made one-quarter full size. This applied chiefly to the cylinders, which in the original must have been a very intricate affair. Anyway, they were all covered with blued sheet steel so the character of the engine was not changed; actually, I did not like producing the blind bore cylinders so I fitted a bottom cover in steel, and on that common cover, concentrically mounted bottom cylinder covers were fastened, located from the bores themselves, as shown in the sketch. I was then able to machine all ports and passages out of the solid, as no receiver pipes are fitted on the original. I had some rather complicated drilling to do. The cylinders were cast in iron. A little trouble was experienced in getting them sound in the H.P.-I.P. valves, but the third attempt produced a perfectly sound casting. In the original, the valves worked direct in the chest bores, but I have fitted bronze liners with stainless-steel valves. It should be mentioned that the engine is a working model, and has run very satisfactorily with compressed air. I have not put steam in, as I did not want to start any rusting.





The complete engine viewed from above

Right—View showing engine in preliminary stages of construction. (Photo by J. A. Smith)

The bosses for the columns were brazed to the bottom cover, as also were the ribs, which extend just inside the cleading line. This bottom cover was also used as a jig for drilling the column spigot holes in the bedplate—so I had no trouble with the alignment of the engine. The pistons are machined for equal weights, the H.P. being of bronze and the I. and L.P. of dural, and are secured to the stainless-steel rods with a taper and nut. The machining of the two splayed columns was a bit tricky, and I learned afterwards that I had followed the same method as used by Savery's. The three turning positions were swung on recessed centres coinciding with the inner face of the flanges.

Valve-Gear

The other columns were machined from the solid, the caps for the reversing shafts being very carefully fitted, but unfortunately I was 20 mils. out in the cross position of the H.P.-I.P. reversing shaft, and the valve-gear, which is a modification of Joys, gave me a hopeless answer. So I checked back my original layout and all dimensions of my components. Everything was correct except the position of the reversing shaft, so I set the valve-gear out again to the dimension I had made it to, and got exactly the same answer on paper that I was getting on the model. I had to make a further set-out to suit the modified position, and finally got the setting correct, which just showed me how essential in Joy gear it is to get the reversing shaft in its correct position. All the valve motion is cyanide hardened—all pins lapped in. The reversing shafts were machined out of solid chunks of phosphor bronze, and had to be very carefully handled in the final stages of machining. My scrapbox confirmed this very definitely !

Crosshead

The crosshead guides are, I think, unique for such a small engine. They were permanently connected to the water circulating system for cooling, the water jacket being bolted to the cast-iron bearing faces; the water inlet is through the hollow bolt holding them to the columns, and discharge is through a union at the top. I was not able to locate the customer for this engine, but it was thought it was supplied to a rubber plantation in Malaya, so the hot climate and 300 lb. of steam in the cylinder block justified the use of the cooling system.

Connecting-rods

The connecting-rods are typical marine practice, except that they left a gap at the bottom end to ensure that the nip was taken direct on the brasses. The crosshead pins are also rather special—they are clearly shown on the Savery general arrangement drawings. The sleeve is internally screwed, hardened and ground, but I could not find out how they tightened up the screws, so I made them hollow and drifted hexagon holes in the inner portions, so that I could deal with them with an Allen key.

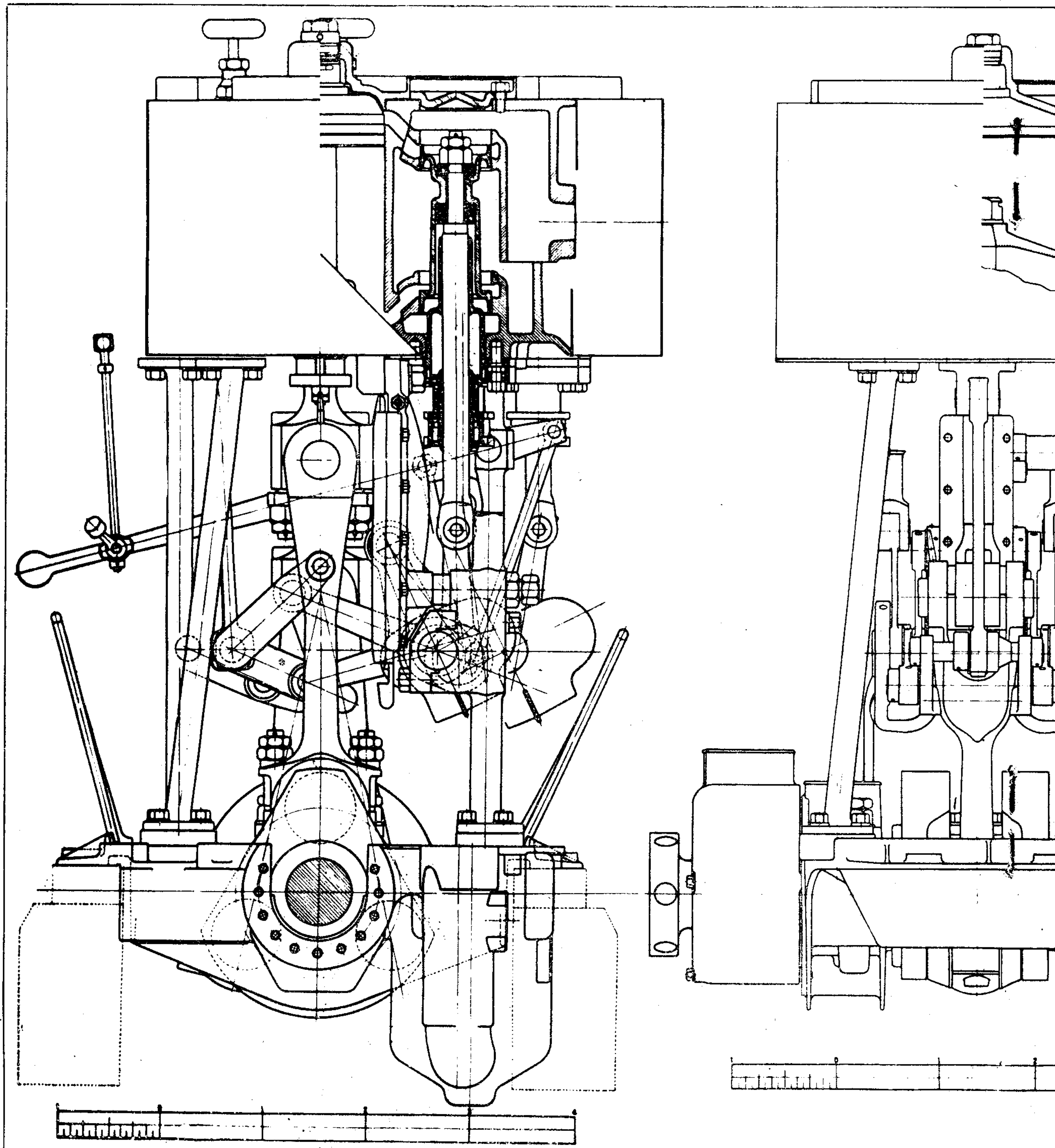
Crankshaft

The crankshaft caused me a lot of thought, and was my first attempt at a solid one, all my locomotives, etc., having built-up ones, but an Xmas holiday saw a completed crankshaft from the solid, balance weights included. The crank-pins needed three tools to get along the length with the small space available for traverse between the balance weights. The shaft runs on five split bronze bearings, and the oiling is looked after by an oil box mounted on the cylinders.

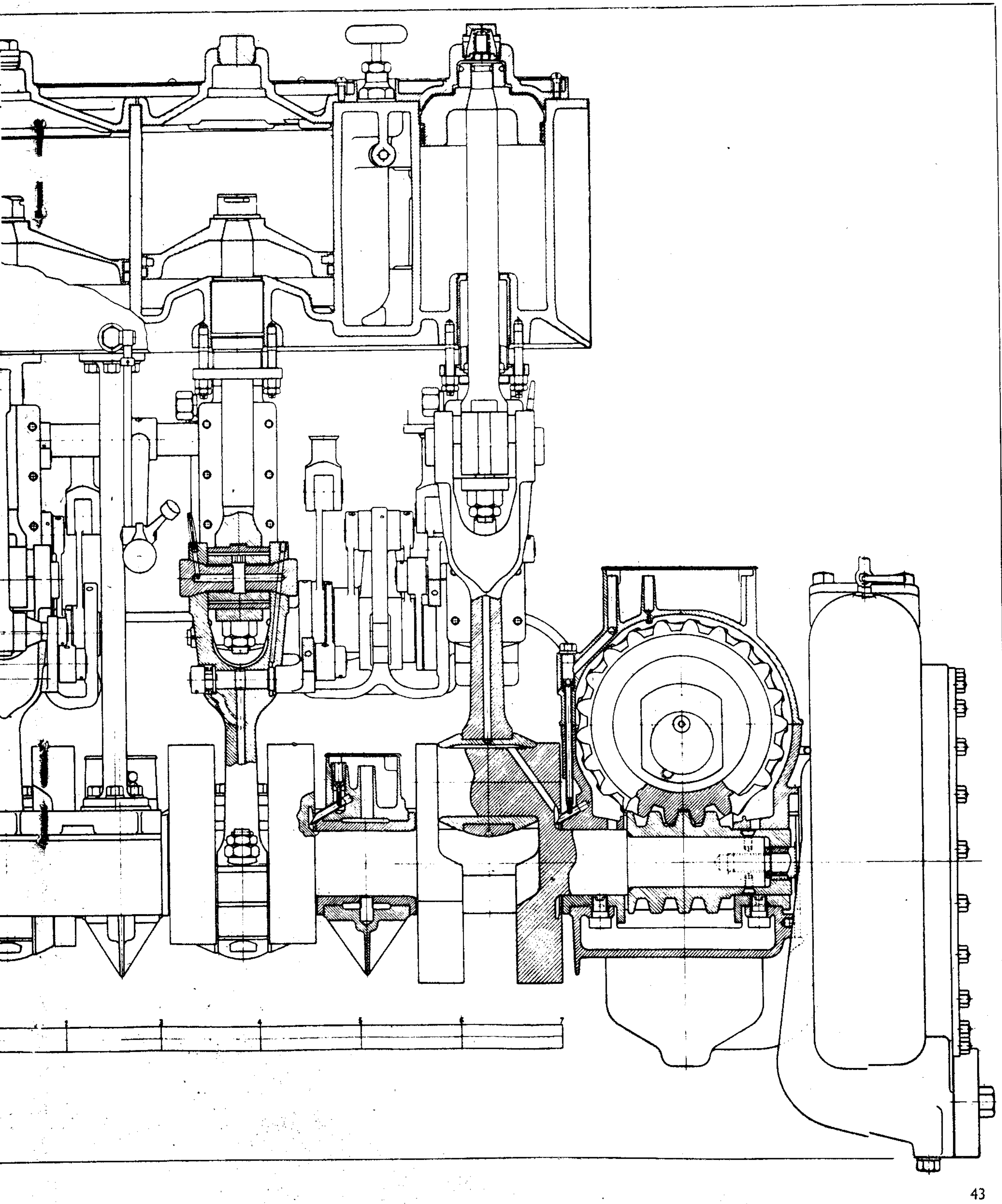
The crankshaft has four thrust collars formed on it and there are eight horseshoes in bronze, each independently adjustable by nuts. The whole is protected by a brass casing with integral oil box on top. At the forward end of the crankshaft, a five-start worm is keyed on, and at the extreme end the 3 in. impeller of the circulating pump. The worm engages an 18-tooth wheel mounted on a cross shaft, which drives the air pump, feed pump and air compressor.

Auxiliaries

The air pump is of the trunk pattern, and fitted with suction and bucket valves, $1\frac{1}{4}$-in. bore by $\frac{3}{4}$-in. stroke. The feed pump is $\frac{9}{16}$-in. bore and $\frac{3}{8}$-in. stroke, the



View from forward end. Pumps and cross-shaft bearing removed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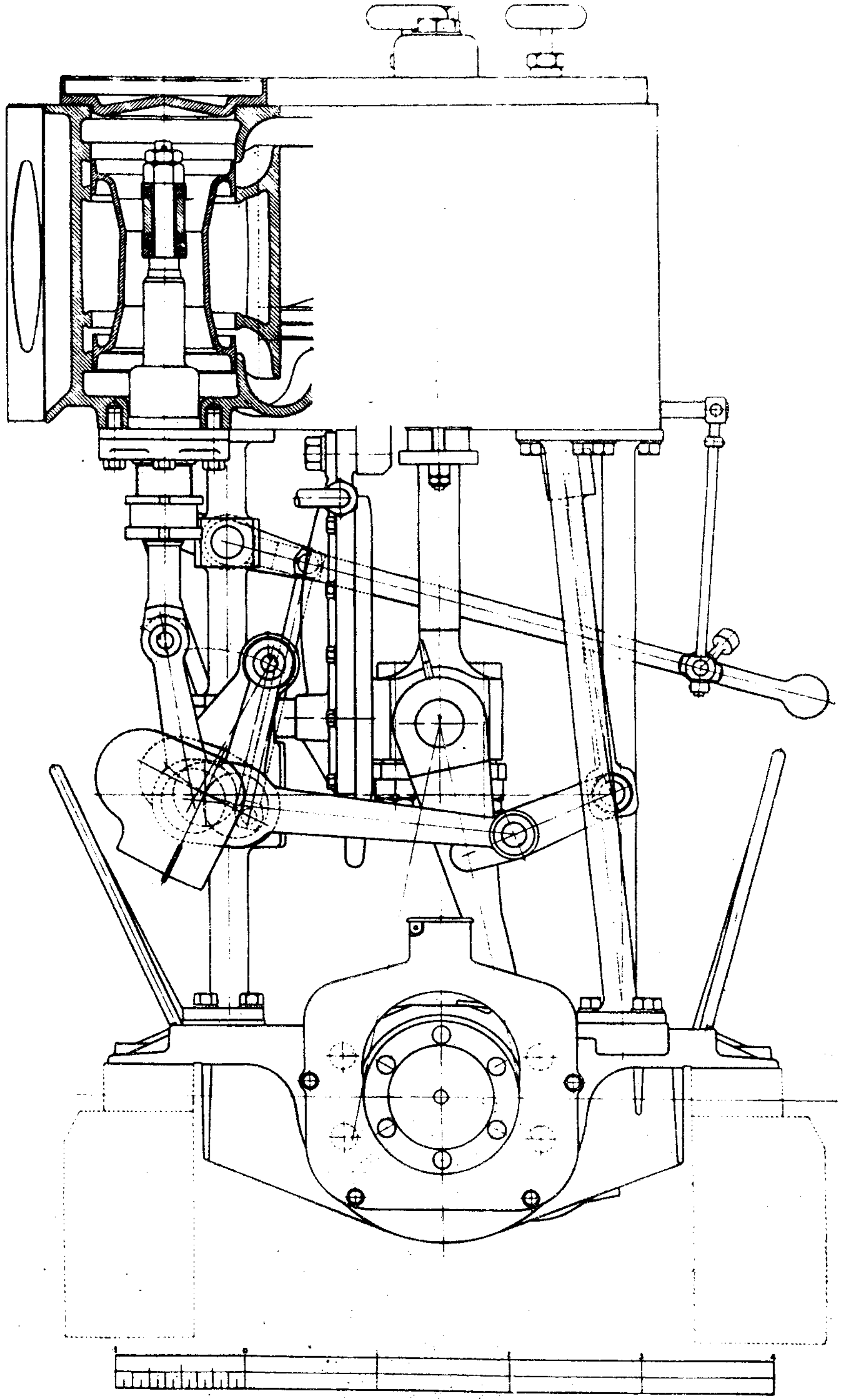
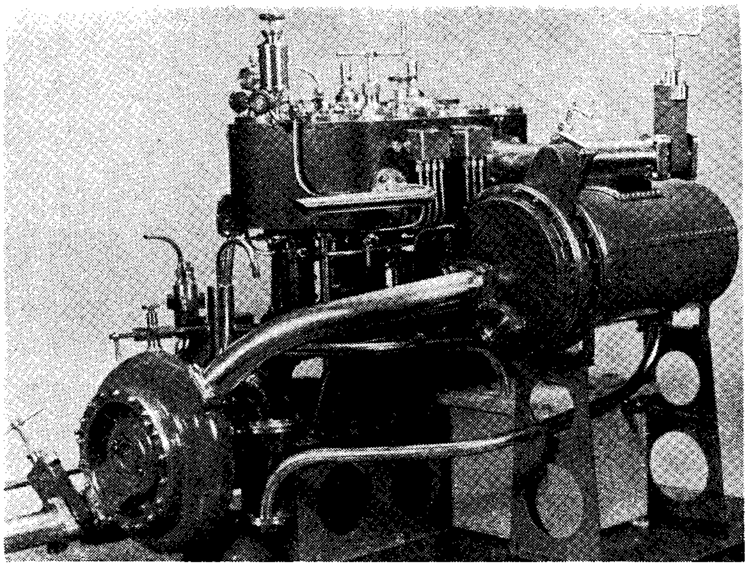


View from aft end, showing L.P. lines only

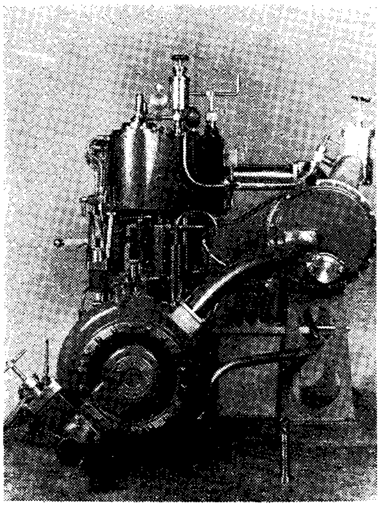
compressor ½-in. bore by the same stroke, and was used for supplying air to the oil fuel burners. The circulating pump is gun-metal, and is of the double inlet pattern. The impeller was built up and silver-soldered together and has 14 blades, seven long and seven short ; it seemed a shame to cover it up, as I was very proud of my effort. Incidentally, the size of the engine is quarter the size of the original and the H.P. is 1¼ in. bore, I.P. 1 5/16-in. bore, L.P. 2¾-in. bore, with a common stroke of 1⅜ in. The original was supplied with superheated steam at 300 lb. per sq. in. ; it ran at 550 r.p.m. and indicated 90 h.p. The condenser was of a very special design to eliminate the need of packed glands to overcome the effects of expansion. Two water boxes were fitted, both at one end, the inner tube plate is fitted with blind-ended tubes and the outer one with smaller open-ended tubes, arranged concentrically in the larger tubes, a total of 80 of each size being used, and what a job it was to feed the one set into the other during erection ! The larger tubes are carried in a baffle plate at the outer end, to prevent steam by-passing the cooling surface. The condenser is of brass, water boxes and steam inlet being built up and silver-soldered, the shell being riveted and sealed with soft solder just the same as destroyer condensers used to be made. The hotwell tank situated under the condenser has an internal partition to prevent the oil scum going over into the feed pump suction. For an extra, Savery's would fit a brass cover on the hotwell tank and also supply oil splash plates ; both these extras are on my engine. I shudder to think of the mess there must have been without

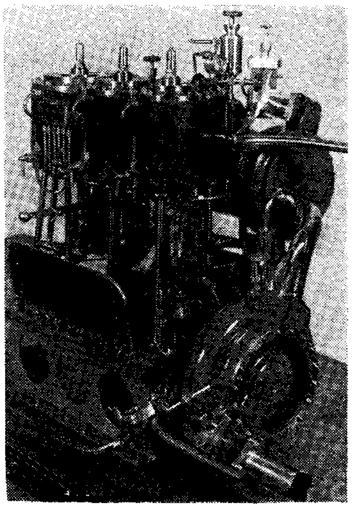
splash plates. The hotwell tank is also provided with a float controlled make-up valve. A removable cartridge-type filter is fitted in the pump suction line. The layout of my engine has been very much compacted so as not to make the glass case too cumbersome, and in actual practice I should expect the condenser to be a few feet away from the engine, also the hotwell. The mounting of the engine on steel flanged bearers is only for convenience. I did mount it on wood to start with, but it looked rather heavy, and made it very difficult to see and get at many parts of the engine. A chain gear has been fitted on the end of tail-shaft, to rotate the engine and see the working of the various parts. I am hoping to motorise this some day. This engine, I think, represents the zenith of this type of open marine quick revolution machinery. As the recent note in THE MODEL ENGINEER indicated, only a few are now left. In fact, I think they are relatively much scarcer than traction engines.

The principal makers that I am aware of in addition to Savery's (I think) were Simpson & Strickland, Dartmouth, Cox's of Falmouth, Sisson's of Gloucester and Davey Paxman's & Mumford of Colchester. I do not know who used to make those used on the Thames in the 1900 period, but have no doubt they also were pretty little bits of machinery. Possibly Plenty's of Newbury made many of them. The drawings I used of Savery's were dated 1913, and I should think that it was probably about the last of this type of engine that they made.



Rear view, showing surface condenser





Bottom left—Forward end view

Bottom right—Three-quarter view from forward end

(Photos by J. M. Holland Macclesfield)

Square-headed Screws

(Continued from page 39)

is disengaged to allow the mandrel to be turned through 90 deg. and again locked. In this way, the head is accurately and quickly squared; but, before removing the work from the chuck, the key should be tried in place in case any slight reduction of diameter is needed to give a free fit.

Milling the Screw Head

To save the labour of filing, a milling operation can be employed to square the screw head.

For this purpose, an indexing attachment is mounted on the vertical slide when secured to the lathe cross-slide. The screw is held in the chuck fitted to the indexing spindle, and an end-mill or a circular face milling cutter is mounted in the lathe mandrel chuck. The cut is put on by traversing the saddle, and the length of the flat machined is adjusted from the cross-slide feed. The vertical-slide is raised or lowered at the end of the cut, in order to remove the curvature formed by the milling cutter and so leave a flat finish. After the first flat has been milled, the work is indexed to 90 deg., and the slide indexes will serve for maintaining uniform machining of the remaining flats.

A twin-cylinder two-stroke engine

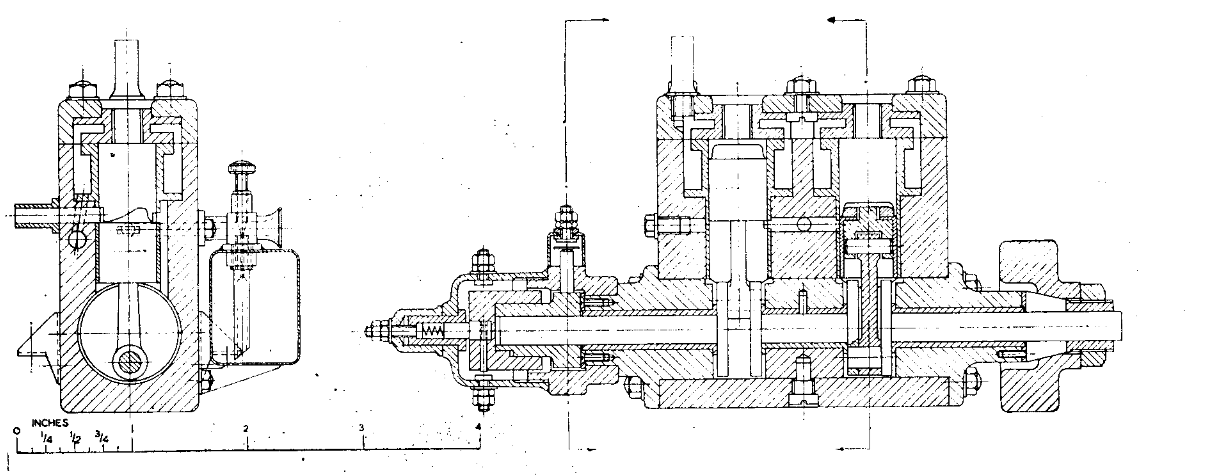
By M. Hollick

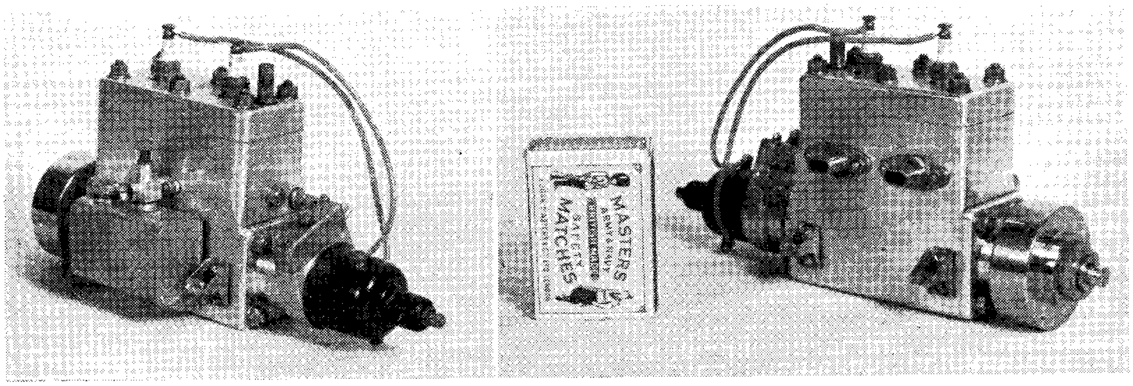
BEING known amongst friends and acquaintances as a chap with an odd and insatiable desire to "machine things from the solid," I am not infrequently the recipient of odd chunks and pieces of metal—usually presented with the remark, "Can you make anything of this ?" Some time ago, in this way, I became the possessor of a nice piece of aluminium alloy, about 5 in. in diameter and $1\frac{1}{2}$ in. thick. The donor would have had great difficulty in finding a more grateful person than I, to present his gift to ; because, for some little while before, I had been jotting down, in odd moments, some schemes for a little twin-cylinder two-stroke engine, and it was quite apparent (carefully ignoring the awful amount of hacking and filing that would be required to bring that chunk of metal to reasonable shape and size) that the problem for my cylinder-block was solved. I almost blush to admit that, before the advent of the aluminium alloy, in my unprincipled search for material I had "borrowed" the 7 lb. weight from the household scales and made one or two tentative and unenthusiastic cuts in it with a hacksaw, but decided reluctantly that it was quite unsuitable.

In due course a number of drawings were produced and eventually a start was made on the job. The engine is a perfectly orthodox two-stroke of the three-port type, with two cylinders of a bore and stroke of $\frac{1}{2}$ in., giving a total capacity of roughly 3 c.c. The only points which are, perhaps, a little unusual in an engine of such a small capacity, are that it is a twin and that it is water-cooled. One other feature in which it differs from the majority of engines I have come across, is the arrangement of the crankshaft—though this is simply a difference of design rather than principle.

In the usual type of multi-cylinder two-stroke engine employing crankcase compression to charge the cylinders, it is necessary to seal off the various portions of the crankcase from one another (except in the case of horizontally-opposed twins, the cylinders of which fire simultaneously). The necessity for separating the crankcase into individual, sealed chambers leads to difficulties of design, and the difficulties are not lessened by another consideration—that the volume of those chambers shall be as small as possible. Another point crops up here, and that is—how to arrange the big-ends in the very confined spaces available in the small crank chambers ? If the big-end is split, in the normal way, and held together by two bolts, its size becomes excessive on a tiny engine, and similar difficulties occur if the big-end of the connecting-rod is a solid eye and the crankshaft built up. One rather neat way of overcoming the difficulty was used in the little "Ladybird" engine, details of which appeared in THE MODEL ENGINEER some while back. The method adopted in that engine, however, made a split crankcase necessary to permit assembly.

These difficulties were side-stepped, rather than overcome, in the present engine, in the following manner. There are three main bearings, and each end bearing is very long, sufficiently long, in fact, to support a simple overhung crank, such as is frequently used in single-cylinder engines ; the end portions of the crankshaft are, in effect, cranks of this type, except that the crankpins extend beyond the unsplit big-ends of the connecting-rods. The centre part of the crankshaft consists simply of a shaft with a disc at each end and the centre main bearing and bearing housing is split, to enable it to be fitted to this part of the shaft. (The two halves of this housing are held together by four screws and the whole assembly is simply a tight push fit in the crankshaft tunnel, any possibility of movement being obviated by a grub-screw.) Each of the discs on the centre part of the crankshaft has a hole bored in it, to receive

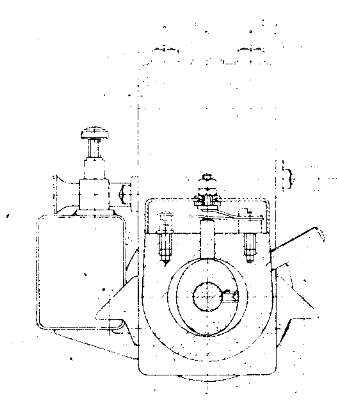




sections of the crankshaft. These holes are at 180 deg. to one another. It will be realised that the effect is simply that of having two overhung cranks, coupled at 180 deg. to each other by a double follower crank. It is essential, with the above arrangement, that the crankpins should be a snug fit in the holes in the discs, which accommodate them ; for although there is no relative movement at this point, the load reversals which occur in the crankshaft would, in all probability, soon cause hammering and rapid wear if there was appreciable slackness originally.

Materials

The material of which the crankshaft is made is 3 per cent. nickel-steel and the bearings for it are of phosphor-bronze, as are the cylinder-heads. The cylinder-head cover and bearing housings are, like the cylinder block, aluminium alloy. The pistons are built up with a 3 per cent. nickel-steel skirt and other portions of duralumin. The connecting-rods are of duralumin also, and are unbushed at both ends, the duralumin itself acting as a bearing metal. "Meehanite" was used for the cylinder liners



and they are of the "wet" type, although the water jacket terminates just above the ports. However, the drilling in the cylinder block for the entry of cooling water runs just below the exhaust ports and communicates with the water spaces around the cylinder liners by means of four further drilled holes, one on each side of each exhaust port, so that each port is, to all intents and purposes, surrounded by cooling water.

The contact-breaker and distributor assembly is fitted at the front end of the crankshaft, and is arranged to rotate about the bearing housing on which it is mounted, so that the ignition timing may be varied. The distributor cover started out in life as the cap of an ordinary electric light plug, and as for the distributor rotor—that must feel the indignity of its present position keenly, on such a small engine, for it is a considerably altered rotor from a full-sized car engine.

Special Points

There are a few other points which merit description and are not clear from the drawings. The cylinder-heads, for instance, are a force-fit in the cylinder-head cover, at the small diameters surrounding the spark-plug tappings ; but in order to ensure that they cannot possibly turn (when tightening up the plugs, for example), a screw (which appears in the sectional drawing, pointing upwards) was fitted into the cylinder-head cover, and the head of this engages with a semicircular recess machined in the larger diameter of each cylinder-head, rather in the manner of a round key.

The flywheel is mounted on a hub, very similar to a collet, drawn into the flywheel by means of a nut. This avoided the necessity of any threads or tapers on the crankshaft. Tapers will hold wheels very satisfactorily, but a well-fitted taper is sometimes rather an embarrassment for it will occassionally hold so well that removal is almost an impossibility, without damage, to the parts. In addition, once the mating surfaces of a taper are machined, the wheel is definitely positioned on the shaft, whereas the "collet" method mentioned, enables the wheel to be secured at any point on a parallel shaft.

Performance

The engine started quite easily on the usual petroil mixture. The performance is satisfactory but not startling, a fact which may be attributed to several causes, among them, the high internal friction created by the long, large diameter main bearings. Incidentally, the crankshaft arrangement I have outlined has other disadvantages—the long centre main bearing, for instance, which increases the cylinder centre distance and consequently the magnitude of the out-of-balance rocking coupling to which this type of engine is subject, as well as the great overall length of the engine. But to those readers who shake their heads sadly over the durability of the layout—I can only say, the engine has done quite a lot of running and no apparent wear at all has occurred ; and, rather surprisingly, vibration is exceedingly slight. The ports, too, were not laid out with the idea of high performance and to those petrol engine enthusiasts uninterested in any engine incapable of fantastic revs and power output would, I suppose, appear grossly inadequate. But to me—and I am sure, some other readers of THE MODEL ENGINEER—an engine which is rather different from the usual run of models always has more appeal than any engine, no matter how potent, which is little different in design, from a hundred others.

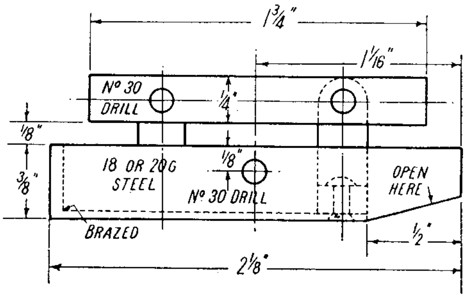
L.B.S.C.'s "Canterbury Lamb" in $3\frac{1}{2}$ in. Gauge

● THE GRATE AND ASHPAN

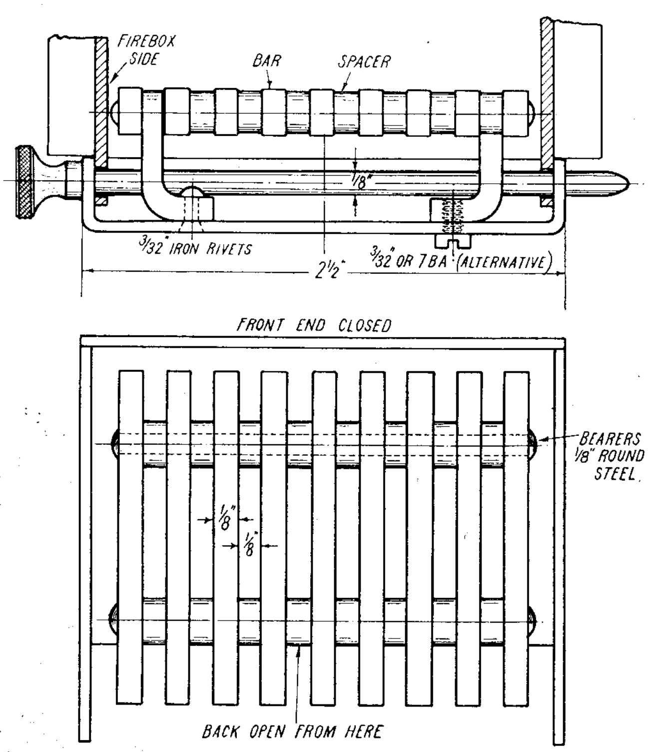
As the distance between the sides of the firebox is greater than the distance from front to back, and the ashpan is necessarily shallow on account of the depth of firebox, I am specifying an ashpan of a slightly different type to the usual kind. The air opening is at the bottom, at the rear of the firebox. This firebox was made as deep as possible, not for the purpose of filling it nearly to the crown sheet with coal, but to use the upper part as a sort of combustion chamber, and keep my proportion of firebox and tube heating surface somewhere near what I have found, by actual personal experience, to be best for efficiency. I also thought it might be possible, as the grate was small, to dispense with an ashpan, without detriment to the steaming of the boiler; but on trying one of my own locomotives of equivalent grate area, without the ashpan, she didn't steam so well, and the fire burnt patchy. Though she has a small grate, she decidedly didn't like a rush of cold air right under the firebars; so I schemed out the arrangement shown, which should do the trick. It is easy to replace after dumping the residue of the fire.

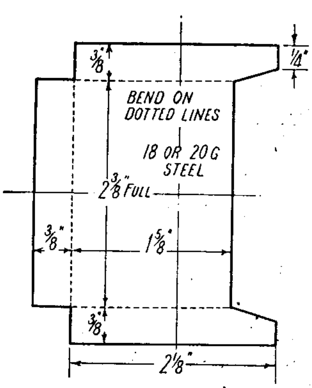
The grate may be cast, or built up as preferred; our approved advertisers won't have any difficulty in casting grates with lugs all ready for screwing to the ashpan. A built-up grate will need nine pieces of black mild-steel strip, $\frac{1}{4}$ in. × $\frac{1}{8}$ in. section and $1\frac{3}{4}$ in. long. Mark out and drill one for the bearers, as shown on the drawing, and use it as a jig to drill the rest. The spacers are made by chucking a bit of $\frac{1}{4}$-in. or 7/32-in. round steel in the three-jaw, centring and drilling No. 30, and parting off $\frac{1}{8}$-in. slices. If the parting tool is ground off at an angle, you won't get any burrs. The bearers are $2\frac{1}{4}$-in. lengths of $\frac{1}{8}$-in. round steel. Drawn rustless steel is good for this job, the bearers last longer than if mild steel is used.

The grate is permanently attached to the ashpan, as on my *Jeanie Deans* and one or two other engines with shallow ashpans, the attachment being made by small brackets bent up from the same kind of material used for the firebars. Cut four lengths approximately $\frac{7}{8}$ in. long and bend one end of each at right angles, a full $\frac{1}{4}$ in. from the end. Drill a No. 30 hole in each, at $\frac{9}{16}$ in. from the outside of the bend. To assemble the grate, knock up one end of a bearer into a rivet head; it doesn't matter about it being rough. Put a firebar on it, then one of the brackets with the



Grate and ashpan





The ashpan "in-the-flat"

End view and plan of assembly

foot pointing away from the head on the bearer, then thread on bars and spacers alternately until bar No. 8 is on. Then put on the second bracket with its foot pointing towards the one already on, then fit the last of the Mohicans, and rivet over the other end of the bearer, hammering both ends as tightly as possible, to keep the grate rigid. The second bearer may then be threaded through the holes at the opposite ends of the bars, putting the brackets and spacers between, to match those already fitted. Rivet over the ends of the bearers, and Bob's your uncle as far as the grate is concerned.

I haven't shown a drawing of a cast grate, because I'm content to leave it to our advertisers, as to how and what kind of lugs they provide. I expect it will be either a round or square boss near each corner, on the underside; it should be $\frac{7}{16}$ in. in length below the bars, and about $\frac{1}{4}$ in. diameter, so that a 3/32-in. or 7-B.A. screw can be put into it through a hole in the bottom of the ashpan. The exact position of the lugs—or should I say legs ?—doesn't matter a Continental, as long as the back pair don't come over the air entry and ash exit.

A Diacro Job!

The ashpan is just the kind of job my Diacro bending brake loves. To make the job easy, I've given a sketch of the ashpan in the flat. Mark it out on a piece of 18- or 20-gauge sheet steel, as per the shape and dimensions shown. If you've a normal strength of wrist, the metal can be cut to shape with a big pair of snips; if not, and you haven't a bench shear, grip one handle of the snips in the bench vice, horizontally, and put a piece of gas-pipe over the other handle, to increase the leverage. Young Curly only had a small and very dilapidated pair of snips, but he managed to cut thick metal, such as the bottom of the discarded kitchen fender, by using that method. Alternatively, use a fine-toothed hacksaw. Bend the metal at right-angles, on the dotted lines—another job which can be done in the bench vice—and braze the front corners, using a bit of soft brass wire for brazing material; or Sifbronze them, if you have the needful. At each side of the ashpan, drill a hole, using No. 30 drill, for the retaining pin; this is located at $1\frac{1}{16}$ in. from the back end, and $\frac{1}{8}$ in. below the upper edge. Be sure to get the two holes in line, to ensure easy insertion of the pin; it isn't possible to fit a guide tube through the ashpan, as I usually specify, because the sides of the ashpan are outside the firebox. The pin itself is merely a 3-in. length of $\frac{1}{8}$-in. round rod, drawn rustless if available, but mild steel will do; form one end into a rounded point, and screw a knob, turned from $\frac{3}{8}$-in. round mild-steel, on the other end.

Stand the grate in the ashpan, in the position shown in the illustration, and hold it temporarily in place with a toolmaker's cramp. If the grate is built-up, the feet may be either riveted or screwed to the ashpan. For the former, just drill No. 41 holes clean through ashpan and feet; countersink those in the ashpan, and rivet up with 3/32-in. charcoal-iron rivets, using the method described for riveting the crown stays to the firebox wrapper. If screws are desired, drill the holes with No. 48 drill; remove grate, tap the holes in the feet either 3/32 in. or 7 B.A., and open out the holes in the ashpan with No. 40 drill, replace grate, and secure with screws to suit the tapped holes. The cast grate can be attached in similar manner, by clamping temporarily in place, drilling holes with No. 48 drill through the ashpan and about $\frac{5}{16}$ in. depth into the lugs. Remove grate, tap the lugs, open the holes in ashpan to clearing size, and secure with screws as above.

Finally, place the assembly in position, seeing that the grate clears the front and back of the firebox by equal amounts; put the No. 30 drill through the holes in side of ashpan, carrying on right through the projecting bottom of the side sheets of the firebox. If the retaining pin is poked clean through the lot, as shown in the end view, grate and ashpan will be held securely, yet they are instantly removable for cleaning out the residue after a run.

Safety-Valve

The safety-valve shown, is a real bit of ancient history; and if Inspector Meticulous doesn't hie himself to "the local" and celebrate my endeavour to please him, I guess I'll be sorely disappointed! It looks like the gadget that adorned not-so-big sister, and will probably work a jolly sight better, as the original boiler couldn't make enough steam to give it any exercise. I fitted a pair of spring-balance safety-valves to my L.B. & S.C.R. engine *Grosvenor*; what my old granny would have called "dead spits" of those on the big engine, and they not only work perfectly, but add the final touch of realism, especially when blowing off. This one should show its full-sized relation, how the job should really be done.

The body of the valve can be turned from $\frac{3}{4}$-in. hexagon rod; while good hard bronze or gunmetal is desirable, brass will do at a pinch. Maybe those enterprising folk who sell castings for my engines, will do the necessary, Anyway, chuck either a piece of rod, or the casting, in the three-jaw, face the end, turn down $\frac{1}{4}$ in. length to $\frac{1}{2}$ in. diameter, and screw $\frac{1}{2}$ in. $\times$ 32, to match the boiler bush. See that the shoulder is truly faced; and if rod material is used, part off at $\frac{5}{8}$ in. from the shoulder. Reverse and rechuck in a tapped bush held in three-jaw; you know how to make tapped bushes by this time—I keep a boxful of them, all sizes, handy to my Boley lathe on which I make all boiler fittings, and advise all and sundry to do the same. It is surprising what a lot of time they save! Turn the outside of the rod, or casting, as the case may be, to the outline shown. Face the end, centre, and drill through, using No. 24 drill; follow with 5/32-in. parallel reamer. Put a small centre-drill in the tailstock chuck, and very carefully enter it in the end of the reamed hole, just sufficiently to take off the sharp edge, or arris, as old craftsmen call it. I know one old Cockney fitter who always prefixed it with "Mrs." probably because there was no H in front! The narrower the seating is, within reason, the longer the valve will remain steam-tight.

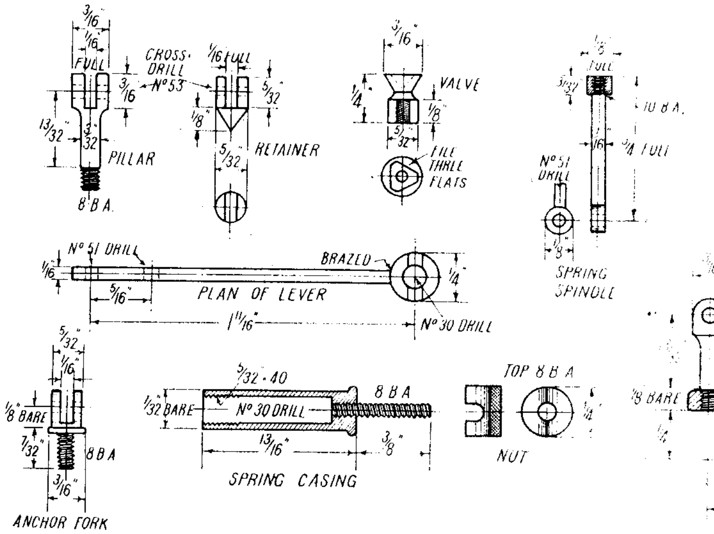
To get the correct location for the pillar, screw the valve body into the bush on the boiler; tighten it up, then make a centre-pop $\frac{5}{16}$ in. ahead of the middle of the reamed hole, exactly on the centreline of the boiler bush. Remove valve body, drill out the centre-pop with No. 51 drill, and tap it 8 B.A., making sure both drill and tap go through dead square, so that the pillar won't stand cockeyed when screwed in. The pillar is turned from a bit of $\frac{3}{16}$-in. square steel rod. Chuck truly in four-jaw, face the end, and turn down $\frac{3}{8}$ in. length to 3/32 in. full diameter with a round-nose tool, leaving the radius in, at the end of the cut. Take a very slight skim off the end, for a bare $\frac{1}{8}$ in. length, and screw 8 B.A., then part off to leave a head $\frac{3}{16}$ in. square. This is slotted and rounded off, just like a valve-gear fork. Eh? Blessed if I didn't think *that* was coming! Bro. Beginner says "how the merry dickens do I hold it for slotting, rounding off and drilling?" He can settle that question in two wags

of a dog's tail, by drilling a No. 40 hole down the end of any odd bit of square rod long enough to clamp under the slide-rest tool-holder, and putting a $\frac{1}{8}$-in. set-screw in the side. Poke the stem of the embryo pillar down the hole, tighten the set-screw, and you'll have what Bert Smiff calls "an 'arry-randall" with which to hold the job for the purposes mentioned. Bro. Beginner also shouldn't forget to put a bit of 16-gauge steel in the slot when cross-drilling the fork, as it prevents the drill wandering, when it strikes the opposite side of the fork. Use as the centre drill used to take the edge off the seating. If your lathe is inclined to chatter, finish the cut by pulling the belt by hand, and the tool will scrape off all signs of chatter-marks. Part off at $\frac{1}{4}$ in. from the end. Reverse in chuck, centre lightly with a small centre-drill, and then make a fairly deep countersink with a No. 30 drill. File three flats on the stem, as shown, to let the steam pass.

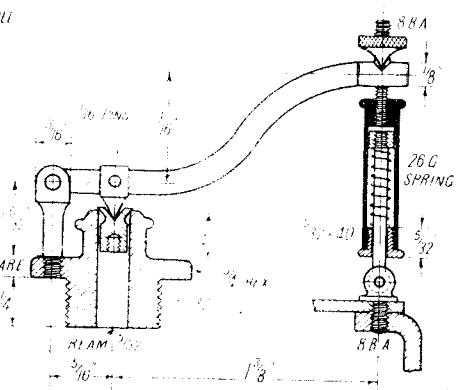
To grind in the valve, put a few $\frac{1}{16}$ in. or 10-B.A. threads on the end of a piece of $\frac{1}{16}$-in. wire about 2 in. long, and screw it into the tapped

The anchor fork is just a dwarf edition of the pillar, and as the detail sketch gives all dimensions there is no need to dilate on how to make it.

The lever can either be bent to the shape shown, from a length of $\frac{1}{16}$-in. $\times$ $\frac{1}{8}$-in. steel strip, or cut to shape from a piece of 16-gauge bright sheet steel. The boss on the end can be made the same as the spacers between the firebars, and brazed to the end of the lever; or the end of the lever itself can be bent into a circle $\frac{1}{4}$ in. outside diameter, thus forming the boss, and the joint brazed or silver-soldered. Cross-nick the boss with a three-cornered file, as shown in the illustration, and drill two holes $\frac{5}{16}$ in. apart, with No. 51 drill, for the fulcrum and valve-retainer pins.



Details of the safety-valve



Section of the safety-valve

No. 53 drill for the cross holes in both the pillar and the valve retainer.

The Little Bits

Drawn bronze rod is the best stuff from which to make the valve. Chuck a bit of $\frac{1}{4}$ in. diameter in three-jaw, and turn down about $\frac{5}{16}$ in. length to a full $\frac{3}{16}$ in. diameter. Face the end, drill No. 54 for $\frac{1}{8}$ in. depth, and tap $\frac{1}{16}$ in. or 10 B.A.; then turn down 5/32 in. of the end to 5/32 in. diameter, a nice sliding fit in the reamed hole in the valve body. Use a pointed tool with a rounded end (says Pat), I always give the tools plenty of top rake for turning hard bronze, and use cutting oil, same as for turning steel. At $\frac{1}{8}$ in. from the end, feed the tool in a bit, to cut a groove; the exact depth doesn't matter, as it is only to provide clearance for the coned part. The cone is easily formed by using a square-nosed tool with one corner ground off, and set to the same angle hole at the bottom of the valve. Put the valve in place, with a scraping off your oilstone, or a trace of flour emery, on the coned part, and twirl it a few times by aid of the wire projecting under the valve body. Wash off all traces of the grinding medium, and remove the wire.

To make the retainer, slot the end of a piece of 5/32-in. round rustless steel or hard-drawn phosphor bronze rod, by method previously described; then chuck the rod, and part off $\frac{1}{8}$ in. below the bottom of the slot. If a piece of $\frac{1}{16}$ in. metal is put into the slot, the retainer can be held in the three-jaw whilst the point is turned. Note—very important, this—the taper must be just a little sharper than the taper of the countersink in the valve, so that *the point only* bears on the bottom of the countersink, below the contact surface of the valve seat; otherwise the valve will be everlastingly "on the dribble." Drill a cross hole, same as that in the pillar.

The spring case can be made from a bit of $\frac{1}{4}$-in. round brass rod held in three-jaw. Face the end, centre, and drill down about $\frac{1}{2}$ in. depth with No. 30 drill, finishing to the full $\frac{5}{8}$ in. with a D-bit. Tap the end 5/32 in. $\times$ 40. Turn down $\frac{3}{4}$ in. of the outside, to a bare 7/32 in. diameter, parting off at 13/16 in. from the end. Reverse in chuck, round off the little bead, centre, drill No. 51 and tap 8 B.A. Screw in an 8-B.A. stud as shown, made from a piece of steel wire, Chuck the $\frac{1}{4}$-in. rod again, face, centre, drill down about $\frac{1}{4}$ in. depth with No. 51 drill, turn down a full $\frac{1}{8}$ in. of the outside to 5/32 in. diameter, and screw 5/32 in. $\times$ 40. Part off at 5/32 in. from the end, reverse in chuck, and round off the bead, same as the one on the case.

The spring spindle is a weeny piston and rod, with an eye on the end of the rod. The piston is merely a 3/32 in. slice of $\frac{1}{8}$-in. brass rod, with a $\frac{1}{16}$-in. or 10-B.A. tapped hole

in it. The piston-rod is a bit of $\frac{1}{16}$-in. steel or brass wire, and the eye can be formed either by bending the end of the wire into a tiny ring, or else silver-soldering a washer on to it, washer being $\frac{1}{16}$ in. thick, $\frac{1}{8}$ in. diameter, and drilled No. 51. The adjusting nut is a $\frac{3}{16}$ in. slice of $\frac{1}{4}$-in. round rod, drilled No. 51, and tapped 8 B.A.; one end is filed to a wedge shape, to engage with the V-nick in the boss on the lever. The other end is knurled for a finger-grip; put a few 8-B.A. threads on the end of a bit of wire held in the chuck, screw the nut on to it, and press on the edge with a sharp flat file, while the lathe belt is pulled back and forth by hand. That is how I always knurl valve wheels and similar oddments: it is quick and effective.

Assembly

First screw the pillar into the valv body, setting the slot in line with the reamed hole, and filing flush any part of the screw projecting below the flange; then screw the body into the boiler bush with a smear of plumbers' jointing on the threads. Pin the valve retainer to the second hole in the lever, with a pin made from $\frac{1}{16}$-in. steel wire, rustless if possible. Ease one end of the wire with a file, squeeze home, and file flush each side. The retainer should be free on the lever. Drop the valve in place, and pin the end of the lever to the slot in the pillar, same as above; the point of the retainer should be plumb in the middle of the countersink in the valve when the lever is horizontal.

On the top centre-line of the boiler, at $1\frac{3}{8}$ in. behind the centre of the valve, drill a No. 51 hole through wrapper and backhead flange, tap 8-B.A. and screw in the anchor fork, smearing the threads with plumbers' jointing. Wind up a little spring from 26-gauge tinned steel wire; the spring only needs to be very light, on account of the leverage. Put the plug on the little piston-rod flange first, then the spring, and screw on the piston; insert the lot into the spring case, and screw the plug home. It only needs to be finger-tight. Put the eye in the slot in the anchor fork, and pin it with a bit of $\frac{1}{16}$ in. wire as described above; drop the end of the lever over the stud on top of the case, screw on the milled V-edged nut, and you're through. The nut can be adjusted when the boiler is in steam, so that the valve blows off at 80 lb. pressure, which is a bit more than the old lady who stands in the market place, ever carried ! Next job is to put on the rest of the fittings, and erect the boiler.

Detecting Faults in Railway Track

WE have been privileged, by invitation of the Railway Executive, to inspect and to travel in a most unusual and extremely interesting railway vehicle which British Railways have brought over by train-ferry from the Continent for trials in this country. It is a track-testing " detective " coach of unusual design, which mechanically records irregularities in the track under load conditions, and gives the engineers data to enable such faults to be corrected. The vehicle is known as the Mauzin coach after its designer M. Mauzin, an officer of the French National Railways and has been brought to England in collaboration with M. Levi, chief engineer of that administration.

The Mauzin track-recording coach is similar in appearance to an ordinary French railway carriage, except that it has 16 wheels instead of the usual 8. It is $48\frac{1}{2}$ ft. long over headstocks and weighs about 50 tons, which provides a load of about 6 tons on each axle, and this presses hard enough on the rails to show whether the sleepers are properly packed with ballast.

Inside the coach is a table over which passes a strip of paper about 8 in. wide. Seven stylus pens rest on this paper and are connected through a system of tensioned wires and pulleys to the axles, or to feeler discs touching the inside faces of the rails. When the coach is in motion, the pens draw on the paper continuous lines which indicate respectively the relative levels of the rails; irregularities in the left-hand rail; irregularities in the right-hand rail; accuracy in gauge width; the variation of cant (super-elevation) on curves; and degree of curvature. Vertically, records are obtained by comparing the level of one axle with the average level of the others; horizontally, the transverse movement of a feeler disc on each rail is compared with that of similar discs fore and aft.

Distance travelled during each test is shown on the strip of paper, and this enables the railway engineers to see at a glance the position of any irregularity.

Any previous recording can be passed through the machine side-by-side with the recording actually in progress, so that a direct visual comparison of the condition of the track on the two separate occasions can be made as the train goes along.

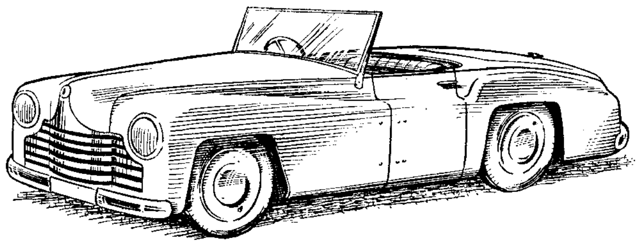
The trials of this French vehicle form the latest development in a long-standing investigation by British Railways to find the most suitable track-testing unit for general use in this country. Consideration is also being given to trying-out in Britain a recording-coach of a different type designed by Amsler & Company, of Switzerland, but it is emphasised by British Railways that these special vehicles only supplement, and do not replace, other track-recording devices already in use here.

British Railways have for many years used the Hallade track recorder, a portable machine which can be taken into any coach and gives a degree of information about the track, but the accuracy of this instrument is limited because the records it makes are affected to some extent by the characteristics of the coach in which it travels; the French coach gives fuller and more accurate information and has been specially designed to pin-point the exact spots where defects occur, so that the necessary adjustments may be made.

This is an advantage over other types of such track-testing devices in which the record is apt to be made at a varying distance from the actual cause of disturbance, according to the speed of the train at the time.

Our run in the coach was from Paddington to Reading and back ; the working of the apparatus was most interesting to watch, every little inequality in the track being immediately and definitely recorded, though nothing of a serious nature was noted. One or two stations had to be passed very carefully, at low speed, where the track is on a curve, because the coach is slightly wider than the widest in use in Britain.

A SPORTS CAR FOR THE YOUNGSTER



By B. W. Francis

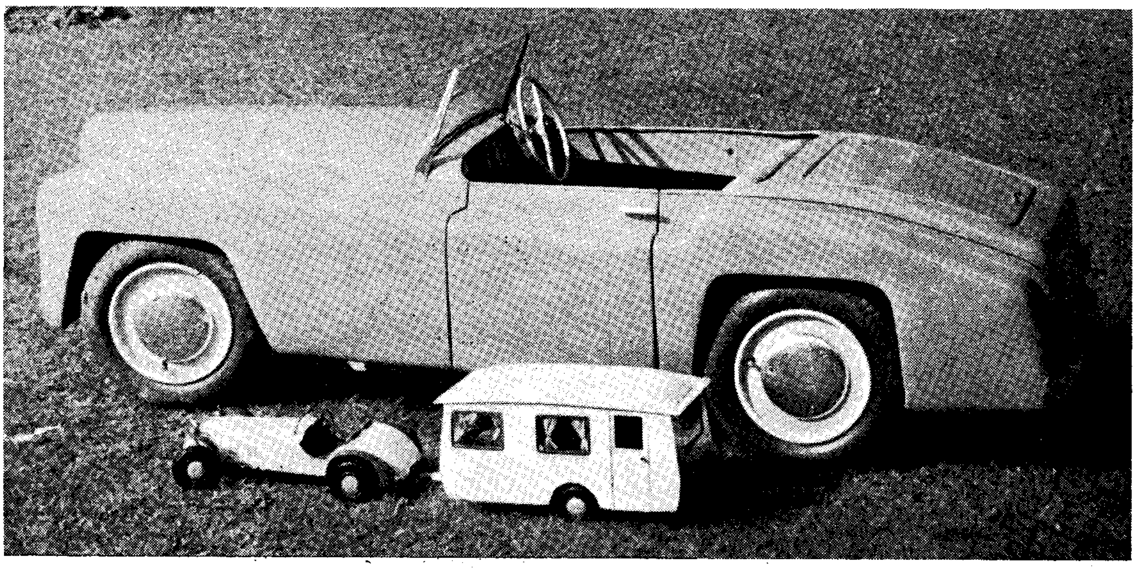
THE reversing mechanism caused much hard thinking and delay. After experimenting much on trying to find a way to lock this unit internally, I gave up in favour of a piece of "mechanism" [?] which would have appealed to the late Mr. Heath Robinson, although as I eventually proved, it works. I should be glad to hear of anyone who has succeeded in doing what I failed to do, so that in the event of building another car, I could incorporate the idea. The main layout of this reverse mechanism can be seen from photographs and needs little explanation (Fig. 11). Fig. 12 shows the gear lever and quadrant with safety catch for reverse. The lever is a M/C spoke chamfered, and a wooden knob fitted. There is an inherent spring to this lever, so in order to select reverse, this has to be pressed down harder than for forward gears. Control-rod to the rear is $\frac{1}{8}$-in. mild-steel and has several guiding stays in order to prevent it bending, as there are both "push" and "pull" strains on it.

Continued from page 23, *January* 1, 1953.

The motor alterations were as follows (Fig. 13). The two insulated brush leads (four brush motor) were severed from the fields and joined together to a piece of cable. I found that mains power cable took all the current without getting at all hot. The fields were treated similarly and both cables were taken to the reversing switch, the principle here being that for reverse the current was reversed in the fields only. The sequence of operation is as follows (Fig. 11) : for forward gears, there is tension on *A*, being the usual pulling strain on speed gears. As *C* is not fixed to *D*, although *E* is pulled as well as *A*, the reverse mechanism is not touched. Conversely, in reverse, gear *E* is pushed, causing *C* to push *D* and move the pegs along to engage in the chain wheel, whereas the spindle *A* can slide into hoop *B*.

The battery is 6 V, which will propel the car for over 12 miles before needing charging, this no doubt being in no small measure due to the free-wheeling action of the 3-speed. I have arranged a means of varying speed and torque, making a smooth getaway possible, by tapping the bars of the battery cells, thereby getting 2, 4 or 6 V. The switch is shown in Fig. 14 and is under the bonnet. The brake is a cycle front brake which is very effective, although appearing rather small ; but when it is realised that the diameter of the car's wheels are less than half those of a cycle, one can understand why.

The wheels are made up, using Dunlop rims, tyres and tubes $12\frac{1}{2}$ in. $\times$ $2\frac{1}{4}$ in. Carrier tubes are better than standard, as they have valves bent at right-angles, thus making inflation easier. Rear hubs are made from tubing which was a sliding fit on the axle shaft with a 2-in. washer welded to the tube and 8-holes drilled in it. A circular



The attractive lines of the youngster's sports car can be seen in this photograph, shown with some smaller models

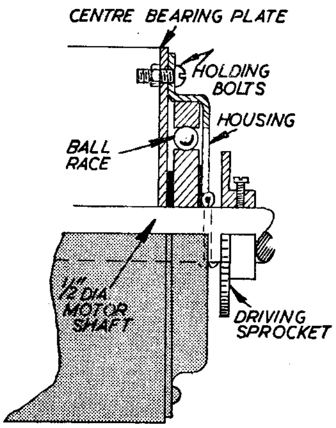


Fig. 10

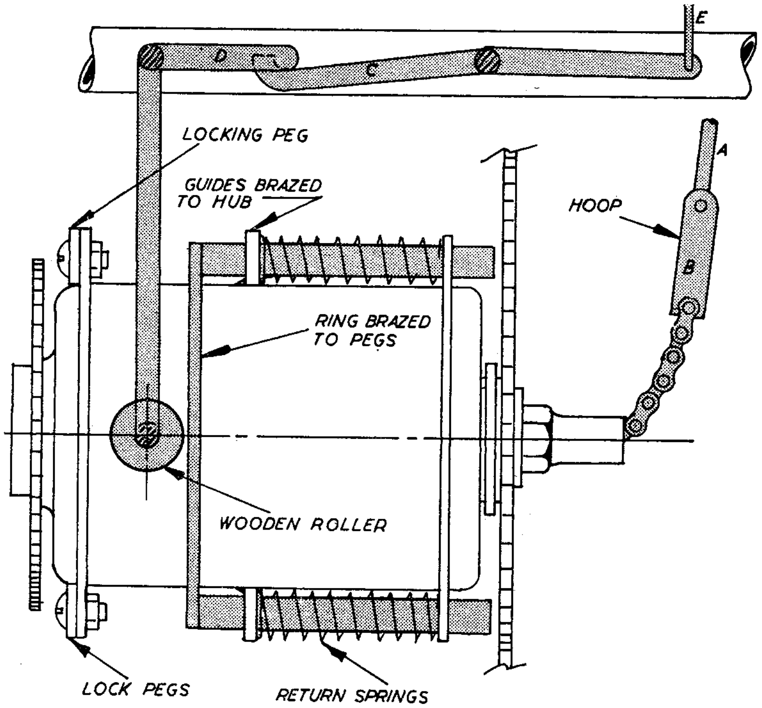


Fig. 11

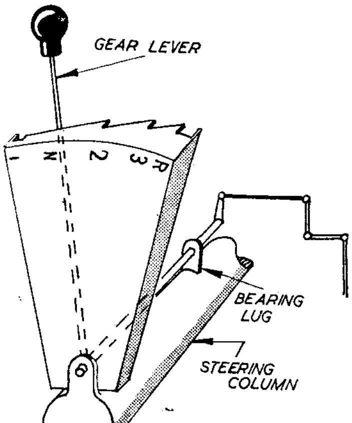


Fig. 12

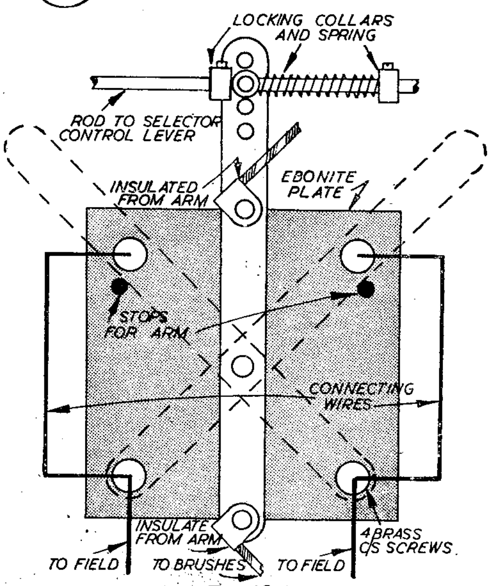


Fig. 13

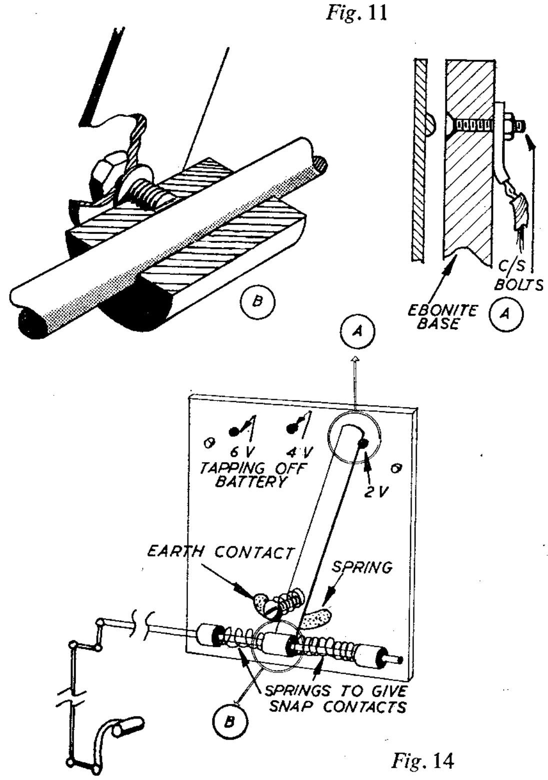
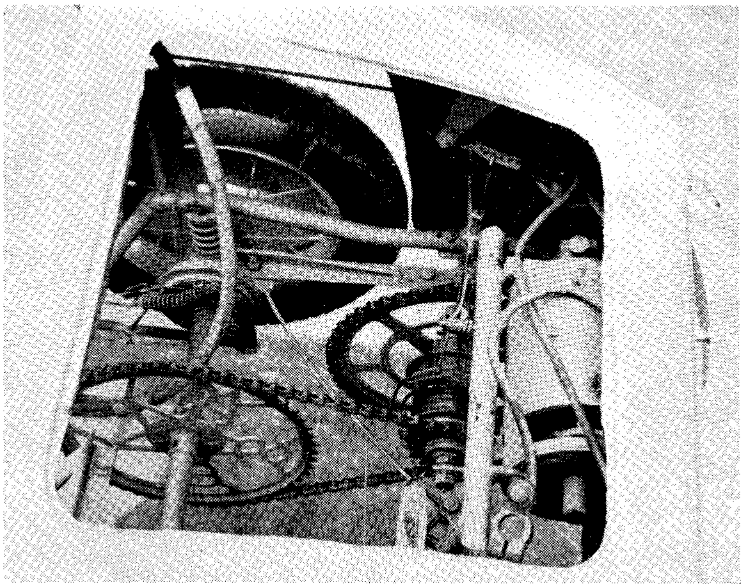


Fig. 14

piece of 24-g. iron was cut and brazed all round the inner edge of the rim, after which the centre was cut out and the hub brazed to it after inserting it through the hole. Spokes were then made and fitted. If the hub is absolutely central, no matter how much the wheel appears to be out of true before the spokes are put in, it is possible to get the unit perfectly true by spoke adjustment. This form of construction makes a very light, strong and good-looking wheel. Front hubs are similar except that the hub is a tube large enough to take a cycle pedal cup at each end, these being brazed in (Fig. 7). When the model was almost complete, I was still not satisfied because I badly wanted to have a door, yet wondered what would happen if I did cut one out, seeing that the body acted as chassis as well. After much thought I took the plunge. Before cutting, I made a frame as shown in Fig. 16. This was made from a cycle frame and fork tubes braced as well. The door was then cut out with a hacksaw. I was well rewarded, for if I stood on the seat, the gap only differed by about $\frac{1}{16}$ in. so with the normal weight of two children, it is static. The door, of course, was exact shape and had only to be cross braced, this by cycle spokes making some triangular shapes. Shaped hinges were necessitated by the bulging sides of the body. An ordinary spring catch was made and fitted.

Wheel plates were formed of aluminium, by beating into an oak block which had been turned to the shape required. These were held to the wheel by three self-tapping screws. Headlamps are also aluminium, made by beating out over a hub cap from a Daimler car. Flutes were cut with a chisel and only the rims polished. The radiator cowl is dural, bent to shape and polished with stripes painted on afterwards. Bumpers and number plates are also dural; the plates were treated as cowl, numbers being left bare. Rear lights are wooden pieces mounted on dural plates and held on with wood screws. The windscreen was made from sheet iron, chromed and fitted with safety glass. Seat is aluminium, fluted for strength. This is upholstered in fawn rexine, fluted as usual; adjustment is by two wing-nuts. The dash is aluminium and instruments are circles painted and numbered accordingly. The boot lid is dural, the front edge has two clips which hook under the body and the rear edge has one spring clip, so that it just springs on or off.



View showing rear axle assembly and the reversing mechanism

The whole car I cellulosed in aqua green, with a red line extending along its length; wheels are in cream. Approximate measurements of the model are: length 6 ft., width 27 in., and it weighs 90 lb. without battery. I was pleased about the light weight, especially after comparing it with models of similar size; I found that most of them are over twice this figure. Top speed is about 8 m.p.h. on level going and gradients of 1 in 4 can be taken easily; in fact, with a fully charged battery, I believe it would be impossible to stop the driving wheel turning. Time taken to construct the model was approximately eight weeks, mostly spare time, but some other as well, I fear.

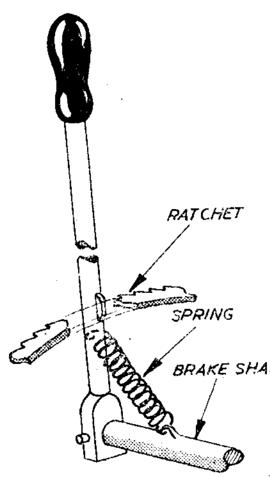


Fig. 15

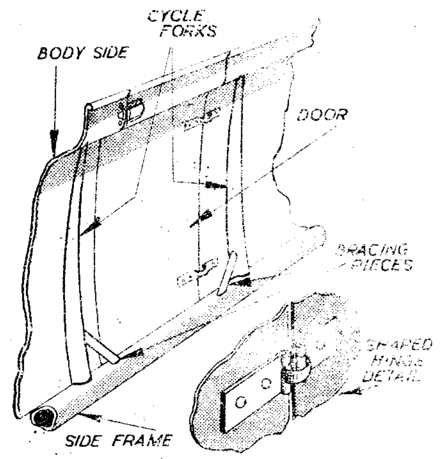


Fig. 16. Details of bracing of door surround

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Scored Mandrel Socket

The morse taper socket of my lathe has become badly scored through using a badly fitted taper shank cutter. Can you suggest a safe way of reconditioning the taper socket in the mandrel without removing it from the lathe?

E. L. (Oslo).

This is not altogether an uncommon occurrence, though it should be possible to avoid it by making certain that all taper shanks fit properly. The usual way of correcting it is to take a very light skim inside the socket with a boring tool. Great care is, of course, necessary to set the top slide to the exact angle of the taper, and it is not the sort of job one could recommend to a novice. If the scoring is not too bad, and there is no question of the accuracy of the taper being affected, a D-bit or reamer can be used to clean up the taper. It is, of course, obvious that this cannot be indulged in too often, as there is a limit to the permissible diameter of the taper socket.

In one case within our experience, the taper has been bored out completely to about $\frac{1}{8}$ in. oversize parallel, and a hardened internal taper bush pressed in. All the methods mentioned could be done without removing the mandrel from the lathe.

The "Kiwi" Carburettor

Will you please let me have the ollowing particulars of the "Kiwi" carburettor as adapted to suit the "Kittiwake" 15 c.c. o.h.v. engine.

(1) *Jet diameter.*
(2) *Needle diameter and taper.*
(3) *Venturi throat diameter.*

—J.E.B. (Nantwich).

The particulars you require are as follows:—

(1) The jet orifice is drilled with a No. 70 drill, but slight variations in size are immaterial, as the jet is regulated by the needle.

(2) The upper part of the needle above the threaded portion is 3/64 in. diameter and is tapered to a point at the end at an included angle of 10 deg.

(3) The diameter of the venturi at the throat, i.e. the smallest diameter, is $\frac{3}{16}$ in. for the standard carburettor for 15 c.c. engines, but this size is subject to variation and in the case of the "Kittiwake" engine, if tuned for high efficiency, a somewhat larger diameter might be found advisable.

Boiler Construction

I propose to make a vertical boiler from $\frac{1}{8}$-in. mild-steel plates.

(1) *Will you please tell me how to fasten the copper tubes in the plate. Are they just expanded in the holes?*
(2) *Is it satisfactory to screw the fittings into the $\frac{1}{8}$-in. plate?*

—T.W.S. (Wallsend).

The usual method of fastening boiler tubes is by expanding them into the holes in the tube plate. It is necessary to have a plate sufficiently thick to get a good hold for the tubes, and the most satisfactory method of expanding them is by means of a roller expanding-tool. This is similar to a caged roller-bearing, having a tapered mandrel inside so that the rollers can be forced outwards, and the cage is then rotated to expand the tube. The outside ends of the tubes are sometimes beaded over after expanding by a special tool to assist in protecting them against burning or erosion.

Small boilers sometimes have the tubes brazed into the tube plate, but this is more common where the boilers are constructed entirely of copper.

We do not recommend screwing boiler fittings directly into the boiler shell; in any case, it is much better to provide bushes which may be welded or riveted to the shell, and internally tapped to take the boiler fittings.

Current for Welding

I am thinking of purchasing a 200-250 V input to 6, 12, 18, 24 V at 25/35 A output transformer, which I think should give me 60 V at, I hope, 35 A. Will this allow No. 16 or No. 14 welding rod to spot weld material up to $\frac{1}{8}$-in. plate, such as model locomotive frames? Can you give me the necessary diagram, including variable resistance? My idea of using such a small transformer, roughly 1.8 kW, is that I wish to make it serve a double service, that of charging through a rectifier. and of welding for a model electric railway.

F.R.T. (Newport)

35 A is a very small current for any useful purpose of welding, and especially for metal of $\frac{1}{8}$ in. in thickness. For spot-welding, a current of near 1,000 to 2,000 A will be necessary, and, in addition, a special form of clamping device to hold the work together. For arc welding, currents from 80 to 200 A and over are used. Also, for welding, the transformer has to have certain characteristics that differ from the ordinary transformer. You could not expect to increase the voltage of your transformer unless there is sufficient room in the winding space to accommodate the extra turns of wire necessary. With regard to using your transformer also for battery charging, this is a matter of providing another secondary winding to give the necessary output you want; if there is room on the core winding space, this will be an easy matter.

Magneto Cut-out

I am fitting a magneto to my 15 c.c. petrol engine, and should be glad to know the best method of connecting a switch in the circuit to enable it to be cut out. I propose to fit this between the low tension terminal of the contact-breaker and the motor frame, so that when the switch is closed the ignition circuit is shorted. Can any harm take place with this arrangment?

J.B. (Cheshire).

The accepted method of switching off nearly all types of ignition magnetos is by earthing, or in other words, short circuiting the primary winding in the manner you suggest. This cannot possibly do any harm, as the voltage in the winding is immediately brought to zero, and is quickly followed by a stoppage of the engine.

The alternative method of breaking the primary circuit to switch off the magneto is not desirable, because if that case the voltage on the open circuit would rise, possibly to a dangerous level, before the engine was stopped. This is, of course, directly opposite to the practice in coil and battery ignition, because in this case, when the primary circuit is broken, there can be no rise in the voltage of the supply circuit.

READERS' LETTERS

●Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

SPHERICAL TURNING

DEAR SIR,—I read with interest the article in your issue of November 20th, on "Making a Ball Handle."

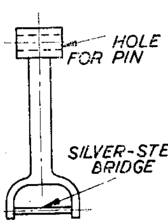
The procedure detailed is, in the circumstances, obviously sound, but I would suggest that, if there are several to make (even over a period of years !) it would in the end prove to be quicker to make the spherical turning tool described and illustrated by "Ned" in your issue of May 12th, 1949.

I have made this tool (with modifications to provide height adjustment for the tool and with provision for varying the distance of the tool holder from the pivot bolt to avoid overhang of the tool) and would offer tardy thanks to "Ned" for his article.

Yours faithfully,
Bournemouth. J. E. ASHTON TAYLOR

AN ELECTRIC CLOCK IMPROVEMENT

DEAR SIR,—I think it may be of interest to many readers of THE MODEL ENGINEER who have built one of the impulse electric clocks which have been described from time to time, if I tell of a trigger and block which I designed to overcome the clanging noise caused by the incorrect engaging of the trigger in the groove in the block.



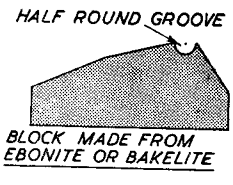
This trouble seems to be encountered by most people who have built this type of clock, and my experiments have resulted in a type of trigger and block which cuts out all noise and also allows more swings of the pendulum to the impulse.

The number of complete swings is often 104 on a 5 volt dry battery and never falls below 85 and without pendulum wobble.

The trigger is in the form of a fork with a piece of $\frac{1}{16}$ in. silver-steel across the prongs through holes in both prongs.

The fork trails back and forth over the block with the silver-steel engaging with a half-round groove in the block instead of the usual sharp trigger and V-groove.

The block is made of ebonite, and before being filed to shape a $\frac{1}{16}$ in. hole was drilled right through from side to side. It was then cut



away till half the hole was left forming a semi-circular groove.

The usual slope was formed for the trigger to slide up to the groove, and a shorter slope at the rear instead of being vertical, as is the case in the usual block.

Yours faithfully,
New South Wales, S. R. COOK.
Australia.

ABOUT HORSES AND PLOUGHS

DEAR SIR,—"L.B.S.C.'s" idea of the "A. & P." Horse of Kent on the front of their rollers reassuring live horses probably had no foundation, but it is the fact that early self-moving road engines were fitted, not with steerage, but shafts to accommodate a horse, led by a boy. This was said to avoid all trouble with other horses !

Ayesha's circular slide-valve had been anticipated in the late '70s on some ploughing engines (Church's patent), but in this case the exhaust port was circular and the steam ports had a somewhat complicated contour, roughly, however, corresponding to the outer edge of the valve. Obviously, in full size, this would make considerable difference to the area of port opened for a given travel of valve (slide a penny over a halfpenny !).

Referring to Mr. Yarnell's letter, the Fowler Ploughing Engines 15218/9 which were the subject of articles a year or two ago have found new owners at Chipping Norton and have been at work again. Apparently shortage of drivers prevents more ploughing tackles being used. There are probably about a dozen working. It is to be hoped that steam ploughing will survive 1956, the centenary of the Fowler Balance Plough, the implement which really put steam ploughing on its feet.

Yours faithfully,
Ruardean, Glos. R. C. STEBBING.

FOWLER ROAD LOCOMOTIVE, No. 15319

DEAR SIR,—You and your readers may be interested to know that my Fowler showman's road locomotive, No. 15319, *Queen Mary*, was on the fairground here at Portland on November 5th and 6th, generating electricity for side-show requirements. The engine was the centre of intense interest, not only from the visiting showmen, but by the general public, there being a constant crowd of admirers and onlookers, many of whom took numerous photographs.

By way of explanation : I purchased *Queen Mary* from Messrs. Richard Townsend & Sons, showmen, of Weymouth, in November, 1950, for preservation, and since that time she has undergone much cleaning and repainting, together with minor adjustments, etc., although the engine is in first-class condition throughout, after 35 years' hard work !

Mr. W. Michael Salmon, M.R.C.V.S., of Dorchester, was in charge of the engine whilst driving the light, and assisted by Mr. J. Hedges and myself. Unfortunately, I was unable to purchase the original dynamo (350 amps.), and have fitted *Queen Mary* with a much smaller one (75 amps.), which is more than enough to provide for side stalls, and light up the two dozen bulbs on the engine. Even so, full use had to be made of the feed-pump and injector, to prevent constant blowing-off, because, of course, there was no real load on her, only the governors could indicate how light the engine was making of the job. However, all went well, and lit up under the canopy with the ruddy glow when the firehole door was open, the mixture of hot oil and steam, the *Queen Mary* presented an unforgettable picture. After much speculation as to whether we should exhibit her at the fair, I now feel that her appearance has been com-

pletely justified, and that she gave great pleasure to a lot of people. I hope to do the same next year, using a bigger dynamo.

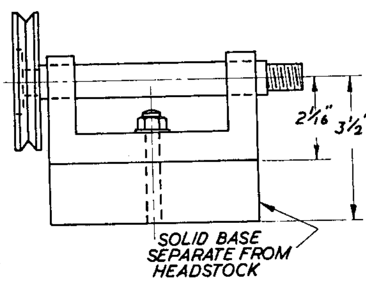
If any of your readers would like photographs, let them contact me.

The engine is kept in the garden beside my house, and I have to dismantle my wife's clothes line each time I want to move her!

Yours faithfully,
Portland. KENNETH COOMBE.

AUXILIARY LATHE HEADSTOCKS

DEAR SIR,—May I also extend to Mr. R. L. Kibbey my congratulations on his auxiliary high-speed headstock. Like him, I had almost reached a point of setting up a smaller high-speed lathe, but his article has decided me otherwise, and I intend making up his headstock with the following modification:



Modification to auxiliary headstock for the M.L.7

The headstock to be in two parts, upper and lower, spigoted and dowelled for positive alignment. Height of centres of the upper half to be $2\frac{1}{16}$ in. This will enable this minor head to bolt on to the boring table of the M.L.7, so forming a very useful milling and drilling spindle, especially when made with a replica of the lathe mandrel nose so all existing attachments will fit. The lower half, of course, to be the right thickness to make up to $3\frac{1}{2}$ in. centre height when in use as auxiliary headstock.

LOCOS WORTH MODELLING

While I am writing you, may I make the suggestion that Mr. Hambleton does an article, in his series "Locomotives Worth Modelling," on the old G.E.R. 10-coupled "Decapod," as data on this locomotive seem so difficult to obtain?

Yours faithfully,
Worcester. A. H. CASTLE.

WITH THE CLUBS

The Bath and District Society of Model and Experimental Engineers

The next meeting will be held at British Broadcasting Corporation, West Regional, on Thursday, January 8th, at 6.45 p.m., when the subject will be broadcast of variety show "Debut." Visitors will be welcome.

Hon. Secretary: A. SMITH, "Redtiles," Rodney Road, Saltford, Som.

Talyllyn Railway Preservation Society

The society, which now maintains and operates the Talyllyn Railway is still in need of new members and is represented at a number of exhibitions, where items of interest are shown including photographs, tickets, models, etc. The official guide, photographs, postcards, obsolete tickets and other items are on sale and the proceeds go to swell the funds which keep this line working.

As examples, there was an interesting stand at the exhibition of the Manchester Model Railway Society on December 18th, 19th and 20th, 1952, and there will be a similar display at the Birmingham & Midland Institute Conversazione on January 8th to 10th, 1953.

The society can supply a film-strip (7s. 6d.) for the use of lecturers and can also supply the lecturers themselves, with a colour film of the line in operation. Advance bookings have been made in a number of areas but other dates can be arranged and all interested are asked to write to MR. H. GRAY, 233, West Boulevard, Harborne, Birmingham, 32.

North London S.M.E.

The model car section of this society took the platform at the December general meeting.

An item of unusual interest was a demonstration of tyre making; a set of four being produced to the great admiration of those who braved the weather to attend.

Future general meetings are as follows:—

February 6th. Film night; March 6th. Rummage sale by auction. All held by courtesy of Eastern Gas Board at their offices in Station Road, New Barnet, at 8 p.m.

Hon. Secretary: W. W. RANSOM, 14, Betstyle House, 197, Colney Hatch Lane, N.10.

The Bristol Society of Model and Experimental Engineers

The annual general meeting took place at the Y.W.C.A., Great George Street, Bristol, on December 6th, 1952. Officers and committees were elected for 1953.

The retiring chairman, Mr. H. M. Webb, was presented by his successor, Mr. H. C. Hodges, with a vertical slide as a mark of appreciation for all he had done for the society during his four years of office. The meeting unanimously approved of a proposal put forward by Mr. B. Harris that the Bristol and West Model Race Car Club should amalgamate with the Bristol S.M.E.E., the request for amalgamation having been put forward by that club.

A letter of appreciation has been sent to Mr. H. W. Woodward who had to relinquish the office of hon. secretary on leaving Bristol.

Hon. Secretary: W. E. ROUND, 14, Britannia Road, Kingswood, Bristol.

The Bedford Model Engineering Society

An open exhibition of models will be held on April 4th, 6th and 7th, 1953.

Times: 4th, 2 p.m. to 9 p.m.; 6th, 10 a.m. to 9 p.m.; 7th, 10 a.m. to 7 p.m., at St. Peter's Hall, St. Peter's Street, Bedford.

Entries for the loan and competition sections should be sent in by February 28th, 1953.

Entry forms are obtainable from: Exhibition Secretary, G. B. SPURGEON, 61a, Goldington Road, Bedford.

The Annual Subscription is £2 2s. 0d., post free, to all parts of the world.

The Managing Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Correspondence and manuscripts should not be addressed to individuals, but to the Managing Editor, THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.